EXHIBIT 20

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN JOSE DIVISION

CISCO SYSTEMS, INC., Plaintiff, v. ARISTA NETWORKS, INC., Defendant.	Case No. 5:14-cv-05344-BLF (PSG)

EXPERT REPORT OF JOHN R. BLACK, JR.

June 3, 2016

CONTAINS HIGHLY CONFIDENTIAL MATERIAL
SUBJECT TO PROTECTIVE ORDER

John R. Black, Jr.

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EXPERT REPORT OF JOHN R. BLACK, JR.

I. INTRODUCTION

1. Arista has engaged me to provide expert testimony to assist the jury on matters related to Cisco's allegations of copyright infringement. Specifically, Arista has asked me to provide opinions as to whether certain combinations of words or phrases, certain "hierarchies" of commands, and certain command modes, prompts and responses asserted by Cisco in this case are original, and whether, or to what extent, such asserted copyrightable material constitutes an idea, procedure, process, system, or method of operation. Arista has also asked me to provide opinions on whether, or to what extent, the similarities between Arista's accused EOS operating system features and Cisco's asserted copyrighted works are subject to the copyright doctrines of "merger," "scenes a faire" and "short phrases." Arista has also asked me to address technical issues related to its copyright misuse defense and its fair use defense, including but not limited to:

a. the purpose and character of the use;

b. the nature of the copyrighted work;

c. the amount and substantiality of the portion taken; and

d. the effect of the use upon the potential market.

Finally, Arista has asked me to opine on various matters related to the foregoing subjects, which are set forth in the body of this Report.

2. I am being compensated for my work in this litigation at the rate of $550.00 an hour. My compensation does not depend in any way on the outcome of this litigation.

3. At this time, I have not created any exhibits to be used as a summary of, or as support for, my opinions apart from those included with this Report. I reserve the right

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to create additional summaries, tutorials, demonstratives, charts, drawings, tables, and/or animations to explain and illustrate my opinions if I am asked to testify at trial.

4. I understand that discovery and litigation are ongoing in this case. I therefore reserve the right to supplement my opinions after I have had the opportunity to review deposition testimony or in light of additional documents or information that may be brought to my attention. Further, if Cisco or its experts change their opinions (either explicitly or implicitly) or provide new information, I may supplement my opinions in response. Cisco has not submitted any of its expert opinions at this time, and so the positions set forth herein are based upon an understanding of Cisco's contentions as revealed in discovery. I am aware of, but have not been able to evaluate all of, Cisco's materials and contentions produced in this case at the close of discovery, including new allegations of copyright similarity regarding help descriptions of commands. Should the Court allow those allegations in the case, I may be called upon to provide further opinions concerning them.

II. BACKGROUND OF ALLEGATIONS AND SUMMARY OF OPINIONS

A. Cisco's Contentions

5. I understand that in this case, Cisco is asserting copyright based on a series of copyright registrations in its Internetworking Operating System (IOS) filed between June 2002 and 2014. Cisco's copyright registrations are attached as Exhibits 3 to 28 to its Second Amended Complaint. The earliest registration is for Cisco IOS version 11.0.[1] Although the registrations claim different releases of IOS, the registrations

[1] Second Amended Complaint Ex. 3.

all recite, as the registered work, code and (in most cases) documentation regarding that release of IOS. I also note that all of Cisco's registrations describe the copyrighted work as a "derivative work," which includes within it "prior works by claimant [Cisco] and preexisting third party computer code" (or similar language).[2] The registrations provide no detail about what parts of the registered works are alleged to be new and what parts were preexisting, what "prior works by claimant" (or "previously published material") the registered works were derived from, or what "third party computer code" is included in the registered works.

6. Cisco provided in discovery a listing of when Cisco contends each asserted CLI command was first published. I note that the registrations attached to the Second Amended Complaint identify the earliest publication date of any of the registered works as October 1, 2009.[3] I understand that Arista requested Cisco to provide an identification of which asserted CLI commands were allegedly present in which asserted work, but that Cisco has yet to do so, and that Cisco also has yet to identify where in each registered work (including any documentation deposited with the registration) each asserted CLI command or other allegedly copied material appears. Should Cisco ever provide this information, I may analyze and incorporate further opinions on it into a supplemental expert report.

[2] *Id.* In some cases, the registrations describe the "[m]aterial excluded from this claim" as "previously published material and preexisting third party computer code." *See, e.g.,* Second Amended Complaint Ex. 25.

[3] *See* Second Amended Complaint Exs. 3-28.

7. I understand that Cisco is not alleging copying of any Cisco source code, whether of a registered work or otherwise.[4] I also understand that Cisco does not allege that Arista had access to Cisco source code.

B. Summary of Opinions

8. As set forth more fully in this Report, it is my opinion that the aspects of the Cisco CLI over which Cisco asserts copyright protection in this litigation—namely, the asserted command modes, prompts, commands, command hierarchies, and command responses—are not copyrightable because the the CLI is a method of operation, and also because the asserted elements lack sufficient creativity and originality, and in many cases were copied from prior systems, industry standard terminology and publications, and well-known and descriptive networking terms.

9. It is also my opinion, as set forth more fully in this Report, that Cisco's copyright assertions over the asserted command modes, prompts, commands, command hierarchies, and command responses are barred by the doctrines of scenes a faire, merger, copyright misuse, and the "short phrases" doctrine.

10. It is also my opinion, as set forth more fully in this Report, that Cisco's copyright assertions over the asserted command modes, prompts, commands, command hierarchies, and command responses are barred by the doctrine of fair use.

11. The factual and technical bases for these opinions and others disclosed herein are set forth in detail throughout this Report. I also incorporate my forthcoming

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[4] As noted, I understand that on May 27, Cisco first alleged infringement based upon similarities of certain "helpdesc" text. I have not had a chance to assess those claims, and I understand that, because the allegations occurred so late in the process, and no discovery was available, there is a dispute as to whether they are properly in the case. If those claims are included in the case at some point, I may be called upon to comment upon them. I do note, however, that "helpdesc" text is readily available to anyone with a functional Arista switch, and it is not necessary to review Arista code to see that text (nor is it necessary to review Cisco code to know what text Cisco EOS uses).

rebuttal and/or reply expert reports regarding copyright issues, my deposition testimony on these issues, and any errata or supplemental report I may serve relating to these and other copyright issues in this dispute.

III. PROFESSIONAL QUALIFICATIONS

12. I am an Associate Professor of Computer Science at the University of Colorado, Boulder. I hold a Bachelor of Science from the California State University at Hayward (now "California State University, East Bay") in Mathematics and Computer Science, conferred in 1988. I received a Doctor of Philosophy in Computer Science from the University of California at Davis in 2000.

13. A current copy of my CV is attached as **Exhibit 1.**

14. I have taught more than 30 classes in computer science, on subjects including Data Structures, Algorithms, Networking, Operating Systems, Software Engineering, Security, Cryptography, Discrete Mathematics, and Quantum Computing. I have authored or coauthored more than 20 publications, primarily on issues relating to computer security. I have been involved with computers for over 35 years in both commercial and academic capacities.

15. I am currently on leave from the University of Colorado for calendar year 2016 in order to start a company in Denver Colorado that aims to transform general computer technicians into computer and network security specialists.

16. I became interested in networks around the age of 12, and began to learn about the only network I had ready access to: the telephone network. Friends and I started a club and began reading Bell Systems Manuals. Shortly after this, I began taking a bus to the Lawrence Hall of Science where I gained access to a room full of teletypes

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connected to a PDP-10 running TENEX. Access to this machine was sold to the general public for a few cents per hour and was the only realistic way a 14-year old boy could play with computers in 1976. This was my first time encountering a Command-Line Interface or "CLI".

17. Shortly after this, the Radio Shack TRS-80 was released and my father purchased one for his business. I then spent every minute I could learning how to program in BASIC and use the TRS-80 CLI. I would spend hours online using a modem at 300 baud to connect to Bulletin Board Systems or "BBSes", hosted around the country.

18. Later my father's business started selling CP/M machines, first from Vector Graphic, then from Osborne and Compaq. I worked for my father while attending college, connecting machines to printers using an RS-232 breakout box to build cables and troubleshoot serial protocols. Later, around 1983, we began selling IBM PCs with MS-DOS and Novell networking solutions to small businesses, which represented my first exposure to a real network, although this predates mainstream use of the Internet, which was still in its nascent stages.

19. Around this time I wrote my first parser and my first CLI for a customer of my father's business. The parser was quite rudimentary and recognized only about 20 different commands, invoking underlying functions depending on which command the user typed in. Later, in a Compiler Design class, I wrote a much more complex "recursive descent" parser for a compiler I had built. Around 1986, I wrote a CLI with a complex parser to interpret commands to run a milling machine that was being productized by my friend Robert Ford.

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20. Attending CSU Hayward from 1984 to 1988, I gained my first exposure to the Internet, which was still an obscurity to most people. The only facilities I used at that time were "telnet", which allowed a user to log into a remote host, and email, which was very cumbersome at the time because DNS was not yet invented. To email a friend on a machine on the same local network, things were pretty straightforward; to email my friends at UC Berkeley required a "bang path" that enumerated the hops over the Internet that would need to be taken in order to reach the Berkeley mail server. For example, I might email my friend Craig Leres using an address like uunet!box!ucarpa!ucb!ucbeng!leres[5]. All four years of my undergraduate computing were conducted exclusively on Unix machines at CSU Hayward.

21. In 1988 I joined Ingres Corp (then called "Relational Technology Inc") as a software developer. The company made and sold SQL database products including an SQL engine that I worked on. I primarily worked on the datatypes facility but at times worked on the parser and optimizer for the product as well. The Ingres parser is the most complex parser I have ever worked on; it was written in a specialized language called "yacc," a language specifically designed for writing parsers. My work at Ingres was conducted almost entirely using DEC VAX/VMS[6] workstations, with a bit of Solaris[7] at times. This was my first time hearing of Cisco, as the company used a Cisco router to provide Internet connectivity and a coworker of mine showed me how to set static routes

[5] The exclamation marks are often called "bang" marks by Unix enthusiasts. I believe it comes from cartoons where the sound made by a gun was often represented by one or more exclamation marks.
[6] VMS is now called OpenVMS. DEC was later acquired by Compaq, which was in turn acquired by HP.
[7] Solaris is a Unix variant made and sold by Sun Microsystems. It is still actively enhanced and sold today by Oracle Corp.

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using the Cisco CLI, around 1991. It was quite natural to use the Cisco IOS CLI given its similarity to TENEX, Unix, and VMS.

22. Around 1993 a different coworker showed me the first web browser, the Mosaic browser, a forebear of the more popular Netscape Navigator. I tinkered around with telnet, connecting to web servers around the world (there were very few of them) to understand how HTTP 1.0 worked.

23. I left Ingres in 1994 and in 1995 started working toward a PhD in Computer Science. My area of interest was cryptography and security. During this time another PhD student was working on developing an exploit for a Cisco IOS buffer overflow and we spent hours trying to get it to work.

24. I graduated from UC Davis with a PhD in Computer Science in 2000 and took a job as an assistant professor at the University of Nevada at Reno. In Fall semester 2001, I taught the networking class there, which included coverage of Ethernet, interior gateway protocols, exterior gateway protocols, ARP, DHCP/BOOTP, IP, UDP, TCP, HTTP, SMTP and other protocols. I assigned several labs, including configuring RIP between two Cisco routers using CLI commands[8]. In 2001 a graduate student, Hector Urtubia, and I looked at the security of ARP[9] and invented a new protocol "AuthARP" to add security to the protocol.

25. In 2002 I moved to the University of Colorado at Boulder to take on a new faculty job. In Fall 2002 I co-designed and co-taught a new course called "Foundations of Computer and Network Security" which included descriptions of security issues

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[8] We had very modest equipment available back then, and did not have access to the simulators and virtual machines that are available for training today.
[9] Address Resolution Protocol, the protocol responsible for mapping between MAC addresses and IP addresses, described in slightly more detail later in this Report

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around Ethernet switches, routers, DNS, BGP, TCP hijacking, HTTP, SSL, and other protocols; I have taught this class 7 further times since then, including modern topics such as wireless networking and Internet of Things, etc. In 2011, I became chair of the Computer Science Department's Computing Committee. As part of my duties, I built a new data center in the basement of the engineering center[10].

26. I have worked for a consulting company at times, writing software on a contract basis. Although most projects here are covered by NDAs, there were several that involved wide-scale networks in order to move large datasets (including genomic data and video data). In one case, I was hired to examine network analysis logs to troubleshoot an Israeli video distribution center's woes.

27. In 2016 I took a leave of absence from CU Boulder to start a company called "SecureSet" in Denver Colorado. The objective of SecureSet is to take reasonably proficient technical people and turn them into computer and network security specialists in 5 months of intensive training. We recommend a CCNA[11] or equivalent as a starting point for our academy and we use Cisco equipment in the classroom.

28. In the past 4 years I have offered the following expert testimony:

i) *EdiSync v. Saba Software, Inc.*, Case No. 01587-WYD-MEH, gave deposition.

ii) *Comcast, LLC v. City of Golden*, Case No. 2013CV31253, gave deposition and testified at trial.

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[10] I "built" it in the sense that I oversaw the design, layout, construction, operational parameters, networking, power and cooling for the project.

[11] A "Cisco Certified Network Analyst" or "CCNA" is a certification issued by Cisco to signify that the holder has a basic competency in building, configuring and managing a network. Cisco certifications are discussed later in this Report.

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iii) *Enfish, LLC v. Microsoft Corp., Fiserv, Intuit, Sage Software, Jack Henry and Associates*, Case No. 2:12-cv-7360-MRP-MRWx, gave deposition.

iv) *City of Thornton v. Verizon Wireless*, Case No. 2014CV34249, gave deposition.

v) *BitTitan v. SkyKick*, Case No. 2:15-cv-754-RSM, gave deposition.

IV. INFORMATION CONSIDERED

29. A list of materials and information I considered to provide the opinions in this Report is provided in **Exhibit 2.**

30. I also included citations to materials I considered throughout this Report. If a document, website, deposition, or any other material is discussed and/or cited in the body of this Report (*e.g.*, RFCs, IETF internet drafts, deposition transcripts, etc.), but does not appear in **Exhibit 2**, I nevertheless considered it to provide the opinions in this Report.

31. Correspondingly, if I did not cite a particular document or transcript listed in **Exhibit 2** within the body of my Report, it does not mean that the document or transcript was not considered.

V. LEGAL STANDARDS

A. Copyrightability and scope of copyright protection

32. I understand that Section 102(a) of the Copyright Act sets forth the subjects of copyright protection, and that copyright protection subsists in original works of authorship fixed in any tangible medium of expression from which they can be

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perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device.

33. I also am informed and understand that to qualify for copyright protection, a work must be original to the author, meaning that the work was independently created by the author (as opposed to copied from other works), and that it possesses at least some minimal degree of creativity. I further understand that copyright in a work protected under the Copyright Act vests initially in the author or authors of the work, except in cases where a work is made for hire, in which case the employer or other person for whom the work was prepared is considered the author of the work under the Copyright Act.

34. I further understand that Section 102(b) of the Copyright Act expressly excludes copyright protection for "any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work."

35. I understand that Section 102(b) codifies the basic dichotomy between expression and idea, also known as the idea/expression dichotomy, and that under the idea/expression dichotomy, every idea, system, method of operation, theory, and fact in a copyrighted work becomes instantly available for public exploitation at the moment of publication.

36. I have been informed and understand that a copyright for a work describing how to perform a process does not extend to the process itself. For example, I have been informed and understand that a book's explanation of a bookkeeping system may be subject to copyright protection, but the system of bookkeeping itself is not

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entitled to copyright protection. Similarly, I have been informed and understand that the copyright for a book describing how to perform a complicated surgery does not give the holder the exclusive right to perform the surgery, and the copyright for a book describing how to perform a 26-step yoga sequence does not give the holder the exclusive right to perform the yoga sequence.

37. I understand that not all copyrighted works are entitled to the same level of protection. I have been informed that a work that is primarily functional, such as a computer program, is generally entitled to only thin copyright protection. I understand that the similarity of expression required to find infringement of a functional work must amount to verbatim reproduction or very close paraphrasing.

38. I further understand that compilations may be subject to copyright protection under Section 103 of the Copyright Act. However, I am informed and understand that while a compilation may be eligible for copyright protection, it must still represent an original work of authorship, and that the bar to copyright protection over an idea, procedure, process, or system also applies to compilations. For example, I have been informed and understand that while a 26-step yoga sequence could be seen as compilation of different yoga poses that was chosen and arranged from hundreds of potential yoga postures, the sequence is nevertheless a process and is therefore ineligible for copyright protection.

39. I also understand that copyright protection may extend to derivative works. I have been informed and understand that Section 101 of the Copyright Act defines a derivative work as a “work based upon one or more preexisting works” that “recast[s], transform[s], or adapt[s]” the preexisting work. I further understand that the

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aspects of a derivative work added by the derivative author are that author's property, but the element drawn from the preexisting work remains on grant from the owner of the pre-existing work. In other words, a derivative author may own the copyright in material the author contributed to a preexisting work, but not in material the author did not create.

40. I have been informed and understand that copyrightability is to be evaluated at the time of creation of the allegedly copyrighted expression, not at the time of infringement.

B. Merger and *Scenes a faire*

41. I am informed and understand that the "merger doctrine" provides a defense to copyright infringement. Under the merger doctrine, courts will not protect a copyrighted work from infringement if the idea underlying the allegedly infringed copyrighted work can be expressed in only one way, lest there be a monopoly on the underlying idea. In other words, the merger doctrine provides that, when there are a limited number of ways to express an idea, the idea is said to "merge" with its expression, and the expression becomes unprotected.

42. I further understand that a merger defense to copyright infringement is evaluated at the time of creation of the alleged expression, and not at the time of the alleged infringement.

43. I am informed and understand that the doctrine of *scenes a faire* is a defense to copyright infringement. *Scenes a faire* are common or standard treatments of a subject matter. I also understand that the *scenes a faire* defense provides that even expressive elements of a work of authorship cannot be the basis of an infringement claim if those elements are standard, stock, or common to a topic, or if they necessarily follow

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from a common theme or setting. For example, I understand that in the literary context, *scenes a faire* include familiar stock scenes, themes that are staples of literature, or situations that naturally flow from a basic plot premise. I also understand that in the computer context, *scenes a faire* includes program elements that are dictated by external factors such as the specifications that the expressive elements comply with, or widely accepted practices within the computer industry. These factors include hardware standards and mechanical specifications, software standards and compatibility requirements, computer manufacturing design standards, industry programming practices, and practices and demands of the industry being serviced. I understand that the purpose of this doctrine is to exclude from copyright protection expression whose creation flowed naturally from considerations external to the author's creativity.

44. I further understand that a *scenes a faire* defense to copyright infringement is evaluated at the time of creation of the alleged expression.

C. Short Words and Phrases

45. I am informed and understand that words and short phrases such as names, titles, and slogans are not subject to copyright protection under the short phrases doctrine, unless they exhibit sufficient creativity.

D. Fair Use

46. I understand that fair use is an affirmative defense against copyright infringement, meaning that if the use of copyrighted materials qualifies as fair use then there is no infringement.

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47. I further understand that Section 107 of the Copyright Act lists four factors the courts "shall" consider in determining whether use of another's copyrighted work is a "fair use":

a. the purpose and character of the use;

b. the nature of the copyrighted work;

c. the amount and substantiality of the portion used; and

d. the effect of the use upon the potential market.

48. I understand that these four statutory factors are not exhaustive. On the contrary, I understand that, in adopting these factors, Congress resisted attempts to narrow the fair-use doctrine to particular categories of presumptive fair use. Instead, Congress urged courts to consider the universe of relevant evidence as to what does (and does not) constitute a fair use.

49. I further understand that the doctrine of fair use requires weighing the strength of each factor relative to other factors in light of the purposes of copyright. Thus, I understand that the limited scope of the copyright holder's monopoly reflects a balance of competing claims upon the public interest: creative work is to be encouraged and rewarded, but private motivation must ultimately serve the cause of promoting broad public availability of literature, music, and the other arts. I therefore understand that the fair use doctrine permits and requires courts to avoid rigid application of the copyright statute when it would stifle the creativity it was designed to foster.

50. For the first statutory fair-use factor—the purpose and character of the use—I understand that the key question is whether the allegedly infringing use is "transformative." That is, the issue is whether the allegedly infringing use adds

something new, with a further purpose or different character, altering the first with new expression, meaning, or message.

51. I understand that the second statutory fair use factor—the nature of the copyrighted work—calls for recognition that some works are closer to the core of intended copyright protection than others. Accordingly, to the extent a computer program is "essentially utilitarian" or "largely functional," it receives relatively weak protection.

52. I further understand that the third fair use factor—the amount and substantiality of the use—asks whether the amount and substantiality of the portion used in relation to the copyrighted work as a whole are reasonable in relation to the purpose of the copying.

53. Finally, I understand that the fourth fair use factor is the effect upon the potential market or actual market for the copyrighted work. I understand that other experts will more directly address this fair use factor, and may base portions of their opinions on some of the technical opinions and analyses I provide on these issues.

E. **Copyright Misuse**

54. I understand that copyright misuse is an affirmative defense against copyright infringement. First, I understand that copyright protection confers a copyright holder with a limited form of monopoly which the holder cannot expand. Second, I have been informed that the misuse defense prevents copyright holders from extending their limited monopoly to control other areas. Third, I understand that a copyright cannot be enforced during the period of misuse.

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55. I also understand that the copyright-misuse conduct need not rise to the level of an antitrust violation. Instead, I understand that the misuse defense's purpose is to prevent copyright holders from leveraging their limited monopoly to allow them control of areas outside the monopoly.

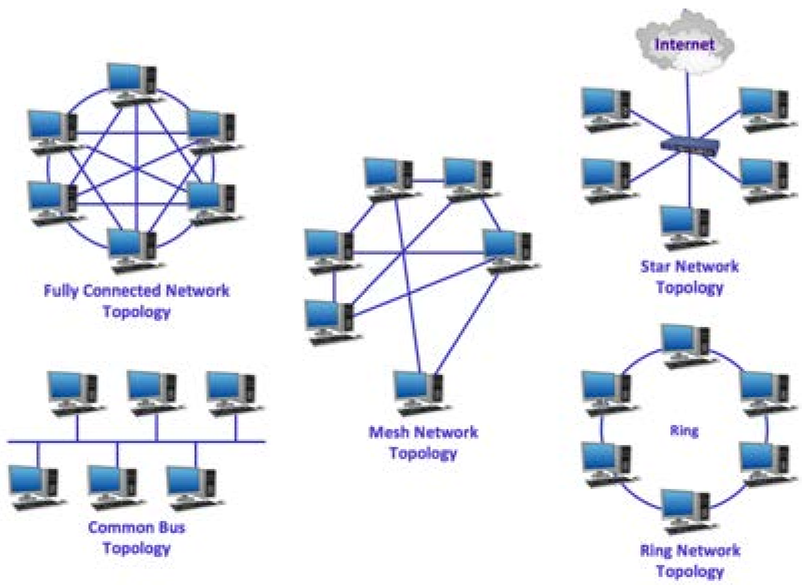
VI. BACKGROUND OF THE TECHNOLOGY

A. Brief Overview of Networking and Network Devices

56. A "network" is the interconnection of two or more computers. Various properties we care about for a network are *inter alia* its speed, range, reliability and security. Fast modern networks virtually always transmit data by encoding them into electromagnetic pulses and then sending these pulses through some medium such as a copper wire, a fiber optic cable, or through the air as radio waves. Networks can span small areas such as a cubicle or home office, but can also reach across a city, cover a planet and even traverse vast distances into space. A network that connects different networks is called an "internetwork" or simply an "internet." The global public network connecting billions of devices together is called the "Internet." (The capital "I" here is deliberate and conventional.)

57. The layout of interconnections of a network is called the "network topology." The simplest network topology is one where every pair of devices has a direct connection. However, this requires an unwieldy number of interconnections if the number of connected devices is more than a handful. For example, if we have 100 computers in a medium sized office building, and we want to directly connect each one to

every other, we would need 5,050 interconnections.[12] This "fully connected" network topology is clearly impractical for all but the smallest networks.



58. In order to build larger networks under practical constraints, we add connection points that aggregate devices to a single point and then connect those aggregation points to other nodes of the network. There are a variety of ways in which this is done, giving rise to various network topologies.

59. One of the most common topologies is the "star" topology (also called "hub and spoke"). This arrangement consists of a set of computers all connected to a central piece of networking equipment. This networking device might be a "hub," a "switch," a "router" or other type of device. These network devices have a series of

[12] The general formula for n devices is n(n+1)/2 connections. In computer science parlance we say the number of connections "grows quadratically" with the number of nodes.

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"ports" where cables can be inserted.[13] A network engineer then configures the devices and connects the various computers so that they can communicate with one another.

60. Every device on a network has a "MAC address" or "physical address," akin to a serial number. MAC addresses are globally unique to that device.[14] For Ethernet (the most ubiquitous wired network protocol), the MAC address is a 48-bit number usually written in hexadecimal with the bytes separated by colons. For example, the MAC address of the computer I am using to type this report is `60:c5:47:0d:30:14.` The first three bytes of the MAC address indicate the manufacturer of the device. In my case the prefix is `60:c5:47`, indicating that my device was manufactured by Apple.

61. To interconnect several devices in a star topology, the most common networking device used would be a "switch." The computers then communicate with one another by sending collections of data called "packets". A packet has the source MAC address and destination MAC address along with the data being transmitted.[15] A switch keeps a table noting which port is connected to which computer and is able to correctly forward a packet from any computer to any other based on MAC address. For example, if a switch receives a packet with destination MAC address `60:c5:47:0d:30:14`, and it knows that the computer holding that address is connected to port 4, it transmits that packet out the wire connected to port 4 (and no other). Of course, modern switches are

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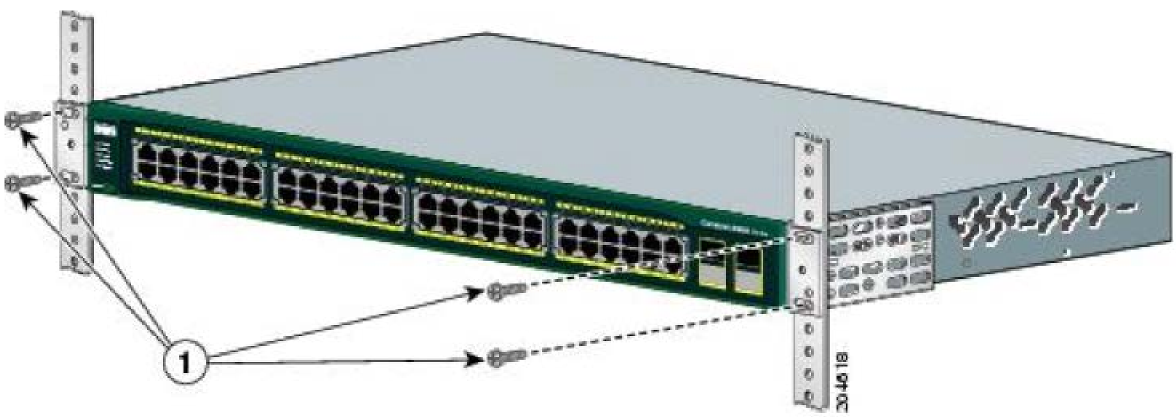
[13] Of course a wireless router need not have any physical ports since the devices connected to it do so without wires.
[14] This is sometimes violated in rare circumstances that we omit for simplicity.
[15] This is somewhat analogous to an envelope carrying the return address, destination address, and containing data (ie, the letter inside).

very sophisticated high-speed devices that can perform these actions in fractions of a second.

62. For a large global network like the Internet, it would be impossible for a switch to keep track of every device's MAC address: this would require a table with billions of entries, and these entries would be constantly changing. Moreover, every device would have to be directly connected to this switch. This is clearly impractical. Instead, switches have at most a modest number of computers connected to them.[16]



A Cisco Catalyst 2960 switch with 48 ports

63. Low-end switches intended for home and small-office use have just a handful of ports and require no special configuration or management; these are called "unmanaged switches." Larger more powerful switches intended for large high-speed networks have an array of advanced features which must be configured by a network engineer; these are called "managed switches." The Catalyst 2960, shown above, is a managed switch.

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[16] A large high-speed chassis switch like the Arista 7500 has 384 ports; most switches have fewer than this.

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64. In order to overcome the difficulties described above, every computer on the Internet gets another address called the "IP address."[17] There are two flavors of IP, called "IPv4" and "IPv6," with the former being the older and predominant form currently in use.[18] An IP address is written as 4 bytes written as unsigned integers with "dots" in between. The IP address of my computer currently is 192.168.1.18. The IP address of the machine I use at work is 128.138.184.134. An IP address is not forever married to a given computer: my laptop will have a different IP address when I am at home versus when I am at work. Some large servers that never move and that have a globally-visible IP address will often be assigned an IP address that remains unchanged for long periods of time; this type of IP address is called a "static IP address."

65. Unlike a MAC address, an IP address indicates where a given device is geographically.[19] This provides a solution to the problem above where switches could not possibly carry a table of all MAC addresses: now another device, called a "router," will simply examine the destination IP address of a packet and forward it in the general *direction* of the destination machine. This is somewhat analogous to how zip codes work in the United States: if a USPS sorting center in New York examines a letter addressed to my home, it will not know exactly where my house is or exactly which route to take to get the letter to me, but it will notice that the zip code starts with "80" and this designates a Colorado address. Therefore the letter will be sent to a sorting center in Colorado from which point it will be forwarded onward. Similarly, if a network router sees a destination IP address of 128.138.184.134, it will not know where that machine is precisely, but it

[17] "IP" stands for "Internet Protocol."
[18] For this report, "IP" will refer to "IPv4" unless otherwise noted.
[19] This is not strictly true, but it serves our purposes here to think of it this way.

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will know that a prefix of 128.138 indicates the University of Colorado, and therefore it will forward the packet in some general direction in order to get nearer to the University's campus routers. Unlike MAC addresses, an IP address does not depend on the manufacturer of the device but rather on the authority that controls the local network where the device was attached. For home users this is usually an ISP like Century Link or Comcast.

66. We can think of "switches" as devices that handle packets with MAC addresses (so called "Layer 2" packets), and "routers" as devices that handle packets with IP addresses ("Layer 3" packets).[20] A simple router intended for the home will often have just a few ports and often will have a wi-fi radio built-in. These routers are managed via a GUI[21], which is friendly for non-technical users. Large high-speed routers require specially-trained network engineers for set-up and maintenance and these devices are often managed via a CLI.[22]

[20] The delineation is unfortunately not this clear cut: there are devices called "Layer 3 switches," which is in fact what Arista makes and sells.
[21] "GUI" (pronounced "gooey") stands for "Graphical User Interface."
[22] "CLI" stands for "Command Line Interface" (or sometimes "Command Line Interpreter"). See further in this report.

A Cisco Linksys WRT54GL home wifi router; this router also has a built-in 4-port switch

B. Networking Protocols and Standards

67. As packets are moved over wires and through switches and routers, various contingencies must be provided for. For example, if an error occurs this must be noticed and handled. If encryption is desired, keys must be exchanged by all computers involved. If a new computer is added to the network, it must be given an IP address. These kinds of coordination tasks are managed by “network protocols.”

68. A network protocol is a set of rules that must be followed by all devices attempting to participate in some activity on the network. Clearly if each manufacturer invented its own rules for network communication, its devices would not interoperate with those made by another company. It is therefore essential that protocols be specified clearly and unambiguously by an authoritative body.

69. Networking technology comprises a vast and dizzying array of protocols. There is a protocol for moving bits across a wire in your home, another for moving those

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bits from a cable modem through the coax cable, and yet another after those bits move onto a fiber-optic cable. There is a protocol for sending bits to your home's wireless router and a different one for sending data from your phone to the nearest cell tower. There is a protocol for assigning IP addresses, another for translating "www.google.com" into an IP address, and another for connecting your web browser to a server. There is a protocol for providing encryption when you browse a secure website. There is another for sending email.

70. These hundreds of network protocols have evolved over time and are designed and promulgated by various groups. Some were invented by companies, others by researchers and others by standards bodies. Some are "proprietary" in the sense that their details are kept private, but most popular protocols are published and promoted as "open standards" in the hope that they will be widely adopted and used.

71. Early and widespread networking protocols invented by companies include SNA (IBM, 1974), DECNet (Digital Equipment Corp, 1975), XNS (Xerox, 1975), IPX (Novell, 1979), and AppleTalk (Apple, 1985). For companies that sold complete solutions, there was little incentive (or perhaps there was disincentive) to interoperate with other vendors' products. However, consumers frequently ended up with a mixture of equipment manufactured by different vendors, and they sought ways to integrate this equipment. As a result, standards bodies began to produce open standards.

72. Of those standards organizations that publish networking standards, the largest is undoubtedly ISO (International Organization for Standardization[23]). Other important standards bodies include ANSI (American National Standards Institute), IEEE

[23] The ISO is comprised of about 160 country-specific member organizations; it has developed over 20,000 standards only a few of which pertain to computer networks. *See* http://iso.org

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(Institute of Electrical and Electronics Engineers), and the EIA/TIA (Electronic Industries Alliance, Telecommunications Industry Association). There are several more groups who focus on Internet standards, the most important of which is undoubtedly the IETF (Internet Engineering Task Force). Other important bodies include W3C (World Wide Web Consortium), and ICANN (Internet Corporation for Assigned Names and Numbers). Occasionally a protocol is jointly developed by two or more organizations; for example, the HTTP protocol (which is the application layer protocol for the web) was jointly developed by the IETF and W3C.

73. Each standards organization has its own naming system for the standards it develops or ratifies. The ISO standards begin with "ISO," (for example, ISO/IEC 7498-1 is the "OSI Reference Model"). ANSI networking standards usually begin with an "X" (for example, X.509 certificate format). IEEE networking standards begin with 802 (for example, 802.3 is Ethernet, and 802.11 is wireless). The IETF publishes RFCs (formerly "Request For Comments", but now best left as an undefined acronym). For example, Internet Protocol Version 4 is defined by RFCs 791, 1349, 2474, and 6864, spanning dates from September 1981 to February 2013. Many of the networking protocols and standards at issue in this dispute are defined by IETF RFCs, although other standards organizations are also relevant to this litigation.

C. **The IETF**

74. The IETF's mission, which is stated on its website, is "to make the Internet work better by producing high quality, relevant technical documents that influence the way people design, use, and manage the Internet." In furtherance of this mission, the IETF adheres to several principles including an open process and protocol

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ownership. Any interested person can participate in the IETF's work, know what is being decided, and make his or her voice heard on the issue. Accordingly, the IETF is committed to making its documents, including RFCs, Working Group mailing lists, attendance lists, and meeting minutes, publicly available on the Internet. Moreover, when the IETF takes ownership of a protocol or function, it accepts the responsibility for all aspects of the protocol.

75. There are different types of RFCs published by the IETF, several of which are described in RFC 2026 (which has been amended several times). For example, an IETF RFC may be on the "standards track," which may include proposed standards, draft standards, and ratified standards. A standards-track IETF RFC may be superseded by another, more recent standards-track RFC, or alternatively may fall into disuse. An IETF RFC may also be classified as a Best Current Practice, or BCP, as described in RFC 1818. IETF RFCs may also be categorized as Experimental, Informational, or Historic, which are not standards-track RFCs. IETF contributions are typically started as Internet Drafts, of which there may be several before the drafts mature into an RFC.

76. As stated in Section 1.2 of RFC 2026, "the process of creating an Internet Standard is straightforward: a specification undergoes a period of development and several iterations of review by the Internet community and revision based upon experience, is adopted as a Standard by the appropriate body ... and is published." Section 1.2 of RFC 2026 further explains that the standards-setting "process is believed to be as short and simple as possible without sacrificing technical excellence, thorough testing before adoption of a standard, or openness and fairness." Still, many RFCs do not

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become ratified as IETF standards, but nevertheless become widely used and adopted across the relevant industry. See discussion below.

77. RFC 2028 further describes the various organizations involved in the IETF standards process, while RFC 2031 discusses the relationship between the IETF and the Internet Society (ISOC), which is a non-governmental international organization providing coordination for the Internet and its internetworking technologies and applications.

78. IETF Working Groups are the primary developers of IETF specifications and guidelines, and typically consist of engineer representatives from a variety of organizations, including academic institutions as well as companies like Cisco, Juniper, IBM, and Arista. It is common from IETF RFCs to list authors or editors, which are typically listed on the front page of each RFC, from several different organizations, including companies that may be competitors in the marketplace. RFC 2418 provides an overview of IETF working group procedures and guidelines.

79. **Appendix A** of this Report discusses several of the IETF standards and protocols (including relevant non-Standards Track IETF RFCs and Internet Drafts) that are relevant to this dispute, and also includes an analysis of the disputed CLI commands that relate to those IETF standards..

D. **The IEEE**

80. The IEEE Standards Association (IEEE-SA) is tasked with developing and maintain industry standards, including networking standards. Like the IETF, the IEEE Standards Association employs working groups to set priorities and develop appropriate

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standards. These working groups are open to everyone and participants need not be IEEE-SA members.

81. **Appendix B** of this Report discusses several of the IEEE standards and protocols that are relevant to this dispute, and also includes an analysis of the disputed CLI commands that relate to those IETF standards.

E. Informal and De Facto Industry Standards

82. In additional to formal standards, which are defined and typically ratified by standards setting organizations, there are also *de facto* standards, which are created simply by the weight of their presence, adoption, and acceptance by vendors and customers in an industry. *See, e.g.*, Robin Shepard, *To Standardize or Not not to Standardize: Is That the Question?*, InfoWorld, Vol. 10, No. 37, Sept. 12, 1988, at 51, *available at* https://books.google.com/books?id=fToEAAAAMBAJ&printsec=frontcover&lr.https://books.google.com/books?id=fToEAAAAMBAJ&pg=PA51-IA19&lpg=PA51-IA19&dq=%2Bd-Link+industry+standard+de+facto+CLI&source=bl&ots=1d9fihTtuB&sig=6VinGnBsPdQ92_jNa_R13mSTFeY&hl=en&sa=X&ved=0ahUKEwjXu4CxgvPMAhXqx4MKHRQ4BlQQ6AEIRTAG - v=onepage&q=%2Bd-Link%20industry%20standard%20de%20facto%20CLI&f=false

83. A *de facto* standard is a standard "in fact" (which is what "de facto" means in Latin), meaning that it is a standard because it has become widely used over time, and not because the standard was developed and approved by a standards-setting body.

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84. The QWERTY keyboard layout is one example of a *de facto* standard that is widely used simply due to familiarity and adoption of keyboard users after being used on the most commercially successful keyboards. *See, e.g.*, Jimmy Stamp, *Fact of Fiction? The Legend of the QWERTY Keyboard*, Smithsonian.com (May 3, 2013), *available at* http://www.smithsonianmag.com/arts-culture/fact-of-fiction-the-legend-of-the-qwerty-keyboard-49863249/?no-ist. Issued in 1878, U.S. Patent No. 207,559 marked the first documented appearance of the QWERTY layout, and that layout was used in typewriters manufactured by Remington (which made guns at the time). *Id.* By 1890, there were more than 100,000 QWERTY-based Remington produced typewriters in use across the country. *Id.* By 1893, the five largest typewriter manufacturers merged to form the Union Typewriter Company and followed QWERTY as the *de facto* standard used across the United States today. *Id.* There was no standards-setting body that ratified a formal industry standard for the QWERTY keyboard layout. *Id.*

85. Another example, which more closely parallels this dispute, is the "AT" command set used by modems. While virtually all modems used it, this was not because a standards committee agreed to develop, adopt, and impose it on the telecommunications industry. Instead, the "AT" command set—where the commands were short sequences of ASCII characters—was developed unilaterally by the Hayes modem company, and then adopted by virtually every other modem maker until it became a standard. *See* Rajana Sharma, *Time not yet running out for high-speed modems*, Network World, Vol. 5, No. 32, Aug. 8, 1988, *available at* https://books.google.com/books?id=OxMEAAAAMBAJ&source=gbs_all_issues_r&cad=1.https://books.google.com/books?id=OxMEAAAAMBAJ&pg=PA31&lpg=PA31&dq=Ha

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yes+AT+command+set+de+facto&source=bl&ots=7Z0H0dQMsd&sig=1FJG40kmvbtIJL MnH0rt2tavgH0&hl=en&sa=X&ved=0ahUKEwjf9u_yh_PMAhWC6YMKHcklCucQ6AEIMj AD - v=onepage&q=Hayes%20AT%20command%20set%20de%20facto&f=false

86. IETF RFCs that are not published as "Standards Track" RFCs, but as other categories of RFCs like "Informational," may also become widely adopted and attain the status of a *de facto* industry standard. Some examples of *de facto* industry standards that were described in Informational RFCs but were already widely implemented in the networking industry at the time they were documented by the IETF, include:

i) "Considerations for Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping Switches" (RFC 4541), *available at* https://tools.ietf.org/html/rfc4541. IGMP snooping is a procedure by which an Ethernet switch can prevent network links from receiving unnecessary traffic, and was described in the RFC as being "based on best current practices." *Id.* Several vendors, including 3Com, Alcatel, Cisco, Enterasys, and HP, were acknowledged as contributors. *Id.*

ii) "RPC: Remote Procedure Call Protocol Specification Version 2" (RFC 1057) (Sun Microsystems, 1988), *available at* https://tools.ietf.org/html/rfc1057). RPC is a procedure that allows a computer program to execute a subroutine on another computer in a network, and was described in the RFC as "a standard that Sun Microsystems and others are using, and is one we wish to propose for the Internet's consideration."

iii) "NFS: Network File System Protocol Specification" (RFC 1094) (Sun Microsystems, 1989), *available at* https://tools.ietf.org/html/rfc1094). NFS is a protocol that provides "remote access to shared files across networks" and was described in the RFC as "a protocol that Sun Microsystems, Inc., and others are using." *Id.*

iv) "Internet Time Synchronization: The Network Time Protocol" (RFC 1129) (1989), *available at* https://tools.ietf.org/html/rfc1129. NTP allows for the synchronization of clocks across all computers on a network, and was described in the RFC as a procedure that "has been in regular operation in the Internet for the last several years." *Id.*

v) "A Convention for Defining Traps for use with the SNMP" (RFC 1215) (1991), *available at* https://tools.ietf.org/html/rfc1215.

vi) "Line Printer Daemon Protocol" (RFC 1179) (1991), *available at* https://tools.ietf.org/html/rfc1179. LPD is a protocol that allows for remotely printing documents on a network computer, and was described in the RFC as "an existing print server protocol widely used on the Internet." *Id.*

vii) "BSD Rlogin" (RFC 1282) (1991), *available at* https://tools.ietf.org/html/rfc1282. This procedure allows a user to remotely log into and use a computer as if they were physically present, and was described in the RFC as documenting "an existing

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protocol and common implementation that is extensively used on the Internet." *Id.*

87. Moreover, even for standards-track RFCs, the drafting process and the publication of multiple drafts of an RFC before it becomes a final published RFC often take years to complete. I have confirmed this by examining the drafts, and the dates on those drafts, for several of the RFCs discussed in this Report. Cisco witness Kirk Lougheed also confirmed at his deposition that the IETF process for endorsing a standard takes "a long amount of time." *See* Lougheed Drp. Tr. at 36. Because the standardization process takes a long period of time, a formal standard may already exist as widely adopted *de facto* standards before they become an endorsed or ratified standard, if such endorsement happens at all.

88. One example of this is the "Routing Information Protocol" or RIP standard. RIP was first documented by Mr. Charles Hedrick in RFC 1058, which was published by the IETF in June 1988. *See* https://tools.ietf.org/html/rfc1058 (ARISTANDCA00022230). The RFC itself states in its first sentence: "This RFC describes an ***existing*** protocol for exchanging routing information among gateways and other hosts." *Id.* (emphasis added). In the "Overview" section of RFC 1058, it further states that one of its intended purposes is to: "Document a protocol and algorithms that are ***currently in wide use for routing, but which have never been formally documented***." *Id.* (emphasis added). This is a clear example of a *de facto* standard that was in wide use before any attempt to document and formalize it took place.

89. Indeed, Cisco witness Mr. Lougheed acknowledged this chain of events regarding RIP at his deposition. When Mr. Lougheed was asked whether he had ever

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asked Mr. Hedrick "for permission to use [the term] 'RIP,'" Mr. Lougheed responded that "Mr. Hedrick formally documented an informal standard that was already in use in the industry for a number of years" and therefore "[i]t wouldn't have occurred to [him] me to ask him for permission."[24] In other words, Mr. Lougheed admitted that the widespread use of RIP as a *de facto* (and not formalized) industry standard meant that it never occurred to him to ask anyone, let alone the RFC's author Mr. Hedrick, for permission to use the term "RIP." *See id.*

90. The *de facto* industry-standard CLI described in this Report shares many similarities with the *de facto* industry standards described above in that the relevant aspects of the industry-standard CLI is widely used by multiple vendors in the networking industry, and has been widely used for a long period of time. As shown in this report, a significant number of vendors support the same command modes, prompts, hierarchies, and commands disputed in this litigation, and many have supported those CLI features for over a decade. The widespread adoption of the disputed CLI functionality across the networking industry is what defines the *de facto* industry standard CLI used by Arista, Cisco, Dell, D-Link, HP, and all of the other vendors discussed in this Report.

F. **Network Operating Systems**

91. The earliest computers were programmed by physically moving wires on the computer itself. However, this was quite time-consuming and burdensome, leading to the invention of "software." Software would be loaded from punch cards into the

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[24] Lougheed Dep. Tr. at 125-126.

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memory of the computer and run until completion. Then another program could be loaded and run after that.

92. These early programs were burdened with managing all of the resources on the computer, such as memory, tape, keyboard, printers, and so forth. It quickly became apparent that users would be better served by having an "operating system" running on the computer that would manage resources automatically and let the user's program merely call an Application Programming Interface (or "API") to communicate with the operating system. A computer operating system is a program that runs at the highest level of privilege, monitoring and managing resources such as CPU, memory, disks, keyboard, screen, networks, and so forth. It facilitates running multiple programs concurrently, arbitrating fair access to resources between multiple users, ensuring reliability and security, and similar other chores.

93. The first operating systems were produced by various companies, many of which are now defunct. A few of the influential early operating systems are listed here, along with the company that created them:

- IBM: OS/360 (1960's)
- CDC: Kronos, NOS (1960's)
- UNIVAC: EXEC I, EXEC II, EXEC 8 (1960's)
- GE: GECOS, GCOS (1960s and 1970s)
- MIT, Bell Labs: Multics (1964)
- DEC: TOPS-10, TENEX, TOPS-20, VMS (1967 and later)
- Bell Labs: Unix (1960's and later)

94. The most significant early operating system listed above is certainly Unix. Although it has evolved significantly since its inception, Unix introduced several key ideas that underlie most of the popular operating systems in use today. Evolutionary descendants of Unix include Linux, BSD, Apple's OS X and iOS and Android.[25]

95. A *computer* operating system such as Microsoft Windows or Macintosh OS X is software that runs at the highest level of privilege and manages resources such as CPUs, memory, disks, networks, keyboard, mouse, screens, printers and so forth. For a network device such as a switch or router, a "network operating system" is typically in charge of managing CPUs, memory, networks and other I/O ports.

96. A high-performance modern networking device can be thought of broadly as having two internal structures: a "forwarding plane" and a "control plane." The forwarding plane is usually constructed with special hardware and designed to be extremely fast: it is responsible for moving packets through the device as quickly as possible while following a complex set of rules. The control plane, however, is responsible for administrative chores, for interaction with the user and for managing the forwarding plane. The forwarding plane does not typically have software one would call an operating system, but the control plane does.

97. Since a networking device is not a general-purpose computer, the operating systems that run on these devices are not the same ones listed above. A general-purpose operating system is tasked with duties such as displaying graphics, playing sound, managing a mouse and keyboard, etc., which are not things a network device

[25] Virtually all large supercomputers run Linux, as well as some enthusiasts who run it on smaller computers. OS X runs on Apple's Macintosh computers. iOS (not to be confused with Cisco IOS) runs on Apple's iPads and iPhones. Android is developed by Google and runs on various smartphones and tablets. The only widely-used modern operating system *not* based on Unix is Microsoft Windows.

needs to do. A network device is primarily concerned with moving packets as quickly as possible toward some intended destination according to some set of rules.

98. A network operating system is either developed from scratch or adapts an existing general-purpose operating system. It is in many ways very similar to a general-purpose operating system: it manages memory, spawns and kills processes, oversees some kind of nonvolatile storage, interacts with one or more users, and (of course) manages an array of networking interfaces. However, unlike a general-purpose operating system, it is primarily concerned with implementing an array of networking protocols such as those described above.[26]

G. **Command Line Interfaces**

99. One of the earliest I/O devices used to communicate with a computer was the teletype. This was a machine with a mechanical keyboard and a roll of paper on which output would be printed.

A teletype much like the one I used in high school. The I/O rate was 110 baud, or about 10 characters per second.

[26] Many networking protocols can be and are supported by general-purpose operating systems, and most any computer can serve as a router, but its performance will typically not be adequate for more demanding environments.

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100. The user would interact with the computer by typing a command on the teletype and pressing return (nowadays this is the "enter" key) which would transmit the command over the serial line to the computer. The computer responded by sending its output back to the teletype which would then print the output on the paper as the paper scrolled up after each line.

101. The earliest video screens were called "dumb terminals" and they sought to emulate the experience of using a teletype: a "cursor" would indicate where the next character would be output, but now as characters scrolled off the screen, they would be discarded instead of printed on paper. But from the computer's vantage point, it was the same as a teletype: commands were entered, interpreted, executed, and the output was returned back. This interface to the computer is called a "command line interface" or "CLI." Once more advanced video technology became available, operating systems began providing GUIs, which most lay users feel is easier to use. However, CLIs remain available for virtually every operating system in use today. The general perception among advanced computer users is that a CLI is more powerful and more efficient for many tasks. CLIs also allow for "scripting," meaning a user can group together a large number of CLI commands in a file and then execute them all together (this is hard or impossible to do with a GUI). A CLI command typically elicits some kind of response, and these responses can be interpreted by an automated process (also hard or impossible to do with a GUI).

102. The general approach of network device manufacturers is to provide a GUI for low-cost devices intended for home users (since most home users would find a

CLI too difficult to use), and provide a CLI for high-end devices used in large production environments.

103. From teletypes to the present, all CLIs have the same basic behaviors as follows:

- The CLI prints a "prompt" indicating it is waiting for user input. For Unix and Linux this is typically "%" or "$". For MS-DOS and Cisco IOS this is ">". For Python it is ">>>". For ftp it is "ftp>". There are countless others.

```
cipher$ █
```

The "bash" CLI of my laptop. "cipher" is the name of my computer. The "$" is the prompt symbol indicating that bash is awaiting input.

- When the user escalates his privilege to "root[27]", it is conventional in most operating systems to change the prompt to "#". This occurs universally on Unix and its derivatives (such as Linux, AIX, Solaris, HPUX, OS X, Android) and on Cisco IOS

```
cipher$ whoami
jrblack
cipher$ sudo -i
cipher# whoami
root
cipher# █
```

Here I have escalated from a normal user "jrblack" to become the root user on my laptop. The prompt symbol changes from "$" to "#". Although this is completely configurable, virtually no one deviates from this convention in my experience.

- If a user simply hits return or enter, the CLI does nothing and simply prints another prompt.

[27] The term "root" comes from Multics and indicates superuser status or administrator status, the highest level of privilege on the machine.

- If a user types a command and presses enter, that command is executed with its output displayed below the entered command, scrolling as needed, and then a new prompt is printed after the command completes its execution.
- If a user types backspace, the cursor backs up and erases the previous character.[28]
- Certain commands would change the context of the CLI, often changing the prompt to indicate the new restricted mode. For example, ftp’s prompt would change from “ftp>” to “(local-file)” and “(remote-file)” for the put command. Bash has a “secondary prompt” called PS2 (by default this is “>”) when it requires further input. Most Networking Operating Systems change their prompts to indicate different modes as well, as discussed further below in this Report.

104. The above behaviors are virtually universal. Over time, more advanced editing features were introduced, such as the ability to move the cursor to the beginning of the current line or end of the current line, or scroll back and forth through previous commands (often with the intent of editing them as just described). For example, in bash ctl-A moves the cursor from anywhere on the line to the beginning. Ctl-E moves the cursor from any position on the line to the end. The left and right arrows can be used to move the cursor back-and-forth across the current line. Typing in the middle of a line inserts the characters being typed. (All of this should be familiar to anyone who’s used a

[28] This was a mess on a teletype since there was no way to “unprint” a character. Instead, a special “rubout” symbol would be printed and you had to mentally visualize how the current line would look. If ever you wanted to see the current line with all edits applied, you would type ctl-L to refresh the line. Cisco IOS also supports ctl-L with exactly the same behavior.

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word processor before.) Additionally, to re-execute an old command, we can use the up and down arrows to scroll through them. Note that every one of these same behaviors was replicated in the Cisco IOS CLI.

105. Most CLIs implement a "command hierarchy" in the sense that the first word typed in the CLI can be followed only be a restricted subset of second words. The second word further restricts that subset to a smaller group of third words, and so on. For example using VMS—an operating system that long pre-dated Cisco—I might wish to examine some system attribute; this is done with the "show" command. But there are many different keywords that can follow "show" depending on what I would like to examine. For example, I could type "show terminal," or "show users," or "show process". Each of these commands can end there, though in some cases I can further qualify them. For example I might type "show device 1DG2," which would show me a specific disk drive. I can further add an option to show me the brief version of the output by typing "show device 1DG2 /brief".

106. Note that the Cisco IOS CLI has the same kind of command hierarchy, and in fact supports "show terminal," "show users" and "show processes" with the same semantics as those commands from VMS given above. And the Cisco IOS CLI sometimes supports the optional addition of "brief" to give a more succinct output; for example a commonly issued Cisco IOS command is "show ip interface brief".

107. The Cisco IOS CLI also uses command keywords familiar to UNIX users, such as "banner" and "motd" ("message of the day"). This is why one of Cisco's first engineers, Kirk Lougheed, who supposedly added the disputed "banner" commands to Cisco IOS, admitted at his deposition that legacy acronyms like "motd" did not originate

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with him. *See, e.g.*, Lougheed Dep. Tr. at 175.

108. If a user enters an invalid or incomplete command into a CLI, most CLIs will return an error message to the user. The error message may differ depending on whether the system recognizes a particular error with the command entered by the user. For example, if the user types "asdf" into the Cisco IOS CLI, which is not a valid IOS CLI command, the CLI will return an error message to the user noting that an "invalid command [was] detected." But if the user types in an incomplete command, such as "aaa accounting," the CLI will return a different error message indicating that an "incomplete command [was] detected."

109. This standard CLI functionality for incomplete or invalid CLI commands is also found in Arista's EOS CLI. If the user types "asdf" into the Arista EOS CLI, which is not a valid EOS CLI command, the CLI will return the following error message to the user: "Invalid input detected at '^' marker." But if the user types in an incomplete command, such as "aaa accounting," the CLI will return a different error message: "Incomplete command."

110. Additional standard CLI functionality typically found in networking equipment CLIs, as well as many legacy system CLIs, include:

i) Command completion functionality, typically triggered by the "TAB" key.

ii) A context-sensitive help system triggered by typing the "?" character into the CLI.[29]

[29] I have been informed that on May 27, Cisco identified for the first time a list of descriptions from the help function that it contends further constitutes copyright infringement. As there has been no discovery exchanged on these contentions, and they were made shortly before the due date for this Report, I have not

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iii) Entering prefixes of command words into the CLI so long as you enter enough letters to identify a command word unambiguously.

iv) Use of a "no" keyword before a CLI command to undo an issued command or to disable a feature.

See, e.g., CSI-CLI-06302874 at 91-92 (Arista EOS User Manual v.4.15.3F); CSI-CLI-00531980 at 1-1 to 1-6 (Catalyst 4500 Series Switch Cisco IOS Command Reference); Remaker Dep. Tr. at 64-65 (discussing command completion and the entering of prefixes of command words in the Cisco CLI). Prefixing a keyword with "no" in order to negate its effect was found in CLIs before Cisco's founding, including in the EECF software taken from Stanford as well as in bash and in the popular vi editor.[30]

111. Support for these standard CLI features extends across multiple networking vendors that compete with Cisco and Arista, including Dell, HP, Brocade, Foundry, Juniper, and many others, as discussed further in this Report. Moreover, some of these CLI features were also supported by legacy systems before Cisco supported them, as also discussed further in this Report. For example, the SUMEX software written by William Yeager at Stanford in the early 1980s supported many of the above CLI features (including command completion, unique command detection, and context-sensitive help triggered by a "?" character) long before the Cisco IOS CLI existed, and the Cisco engineer who purportedly wrote the first Cisco routing software CLI, Kirk Lougheed, admitted that he was familiar with Mr. Yeager's SUMEX software. *See*

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been able to form any opinions regarding them. I can confirm, however, that help descriptions on Arista software are available to anyone with a working Arista switch and are not confidential. By simply typing a "?" on an Arista switch one could have learned of the descriptions Cisco identified.

[30] For example to turn off the bell sound in bash, you type "set nobeep." To turn off autoindent in vi, you type "set noautoindent".

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Lougheed Dep. Tr. at 233-235.

112. Mr. Lougheed confirmed at his deposition that these CLI features, even at the time that the SUMEX software was in use at Stanford, were "common" in almost all parsers. *See* Lougheed Dep. Tr. at 233-235 (emphasis added); *id.* at 235 (confirming that the SUMEX parser actually supported this functionality described in the user manual); KL-00000001 (Stanford SUMEX reference manual entitled "A Multiple Protocol Kernel for Local Area Network Software Development Reference Manual" that Mr. Lougheed had in his files).

113. User documentation for CLI commands differ by vendor. However, many CLI commands are documented in a manner that requires or allows the user to select from multiple mandatory or optional command keywords that impact the behavior of, or alter the functionality of, the command when it is accepted as a valid and complete command by the CLI. User documentation for CLI commands also may require or allow the user to input values (*e.g.*, a particular IP address or configuration value, etc.) that impacts the behavior of, or alters the functionality of, the command when it is accepted as a valid and complete command by the CLI. I will refer to those user-inputted values in this Report as "arguments."

114. Different vendors may use different visual conventions (*e.g.*, bolding, italics, bracketing, etc.) in their documentation to denote keywords and arguments in their command reference manuals. User documentation from different networking vendors may also differ on on the terms that they denote to be optional or mandatory keywords versus terms that they denote to be part of the root command terms. For example, the user documentation for one vendor may denote "aaa accounting" to be root command

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terms and identify several mandatory (or optional) keywords that must (or may) be added immediately after those terms, such as "dot1x." A different vendor, however, may denote "aaa accounting dot1x" to be root command terms, and identify several mandatory (or optional) keywords that must (or may) be added immediately after those terms. Therefore, the syntax for a valid and complete command may be documented in a command reference manual differently depending on the vendor and networking device.

115. As an example, Cisco IOS command reference manuals generally follow the following command syntax conventions:

Convention	Description
bold	Bold text indicates commands and keywords that the user enters as shown
italic	Italic text indicates arguments for which the user supplies values
[x]	Square brackets enclose an optional keyword or argument.
...	An ellipsis (three consecutive nonbolded periods without spaces) after a syntax element indicates that the element can be repeated.
|	A vertical line, sometimes called a "pipe," that is enclosed within braces or square brackets indicates a choice within a set of keywords or arguments.
[x | y]	Square brackets enclosing keywords or arguments separated by a pipe indicate an optional choice.
{x | y}	Braces enclosing keywords or arguments separated by a pipe indicate a required choice.
[x {y | z}]	Braces and a pipe within square brackets indicate a required choice within an optional element.

116. Arista EOS user documentation follows a different convention for documenting the acceptable command syntaxes for EOS CLI commands, which can be seen by comparing the ARISTA EOS User Manual and Cisco IOS user documentation

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side-by-side.

117. Many CLIs, including shells like bash (the default CLI shell on most Linux systems), also support functionality called "command aliasing." Command aliasing makes it possible to invoke a command (or group of commands) that the CLI would recognize as a valid command by entering a different preset string. In other words, it allows a user of the CLI to create different words or abbreviations as an alias for a command (including any mandatory or optional keywords for that command), and use that alias in the same way that the original command is used. This is normally done because the user types in the same long command frequently and he or she wishes to have a shorthand command that does the same thing. For example, if a user types "show ip interface brief" quite a lot, he or she may prefer to create an alias like "shbr" that can be typed in instead, and the operating system will expand "shbr" to "show ip interface brief" automatically.[31] Cisco IOS, Arista EOS, HP ProCurve, HP Comware, and others support this functionality. By way of example, a user could use this alias functionality with HP Comware and create aliases for "display" commands that allow the user to type in "show" instead of "display." In EOS, the "alias" command is used to create an alias for a CLI command. Once an alias is created, entering the alias into the EOS CLI executes the corresponding command.

118. There are other user interfaces commonly used to facilitate interaction between a human and a computer. The most well-known of these would be a GUI. When an engineer or artist or web-designer designs a GUI, there are many choices about how to organize the interface into buttons, pull-downs, sliders, menus, text windows, etc.,

[31] The user will not see the expansion of "shbr" to "show ip interface brief"; the system will simply interpret "shbr" to mean "show ip interface brief" internally.

as well as what fonts to use, font sizes, graphical images, animations, and so forth. A GUI is a very “content-rich” experience with a large array of design decisions for the creator. In fact, how best to design a user interface of this kind is considered a research area within Computer Science typically called “User Interface Design.” One can take classes, read books, attend conferences, and even obtain a PhD in User Interface Design. But, in my experience, no one has ever offered a class, written a book, written a research paper or earned a PhD related to the design of a command line interface.

119. Although there certainly are design choices to be made when designing a CLI, the choices are relatively few: what prompt to use, what modes to use, what keywords should be used and in what order, etc. Most software authors elect to simply follow the conventions of the CLIs that preceded it, just as the authors at Cisco, Arista, Juniper and other NOS vendors did. In my opinion, they did this because the value in retaining the familiar feeling and behavior of preexisting CLIs exceeded any advantages that might be obtained by making a different type of CLI. Moreover, it really was not and is not possible to make a dramatically different CLI given the inherent constraints on that interface method: there are just not that many choices to be made on how to organize a finite set of words into a set of short commands.

H. **Cisco IOS and other Cisco OS**

120. Cisco IOS comprises a family of network operating systems. It is designed to run on hardware designed, manufactured and sold by Cisco Systems, Inc. (or simply “Cisco”). [redacted]

[redacted] Cisco's original user interface was solely the CLI provided via a serial port on the device. In the subsequent 30 years since its initial product release, Cisco has developed a large array of products including switches, routers, firewalls and other networking devices aimed at the enterprise, service provider, data center, and home markets. Along the way, Cisco IOS has been "forked" to provide features specific to other kinds of product lines. Although "IOS" is sometimes used as an umbrella term to capture all Cisco "IOS like" operating systems, Cisco distinguishes variants of its mainline IOS product with names like "IOS XR", "IOS XE", and "NX-OS". IOS XR was aimed at the service provider market and used a new microkernel called QNX. IOS XE is a Linux-based variant aimed at the enterprise market. And NX OS is a variant spawned for its Nexus product line, aimed at the data center market.

121. Although GUIs have sometimes been provided for selected Cisco products, and although management protocols such as SNMP and NETCONF/YANG have been implemented in most Cisco products, the CLI is ever-present as an available interface to Cisco's devices and the one that most engineers know best.

122. In 1998, Cisco introduced its certification program by announcing the CCNA ("Cisco Certified Network Associate") which required that aspiring Cisco experts pass a comprehensive exam covering a range of networking technologies. Many of the exam questions then and today require specific knowledge of Cisco IOS, and the only interface used for these exams is the CLI.[33] Since this time, Cisco has greatly expanded

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[redacted]

[33] This statement is to the best of my knowledge. If any other interface is used on any Cisco certification exams, I am unaware of it.

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its training and certification program to include other levels of proficiency and domains of expertise, though the CCNA remains a valuable and widely-sought certification by aspiring network engineers. The most prestigious and difficult certification offered by Cisco is the CCIE ("Cisco Certified Internetworking Expert").[34]

123. [redacted]. I would expect that the number of commands has risen substantially since 2009. I also understand that Cisco represented in its court filings in its litigation with Huawei in 2003 that Cisco IOS software, at that time, consisted of approximately 15 million lines of source code. *See* CSI-CLI-3838822 at 5 (Cisco's Motion for a Preliminary Injunction). [redacted]

124. I am aware that for a number of years Cisco publicly described its IOS CLI as "industry standard," and I will discuss and provide further illustrations of the "industry standard" CLI--both as used by Cisco, and as used and adopted by other vendors in the networking industry--throughout this Report. *See e.g.* ARISTANDCA00010591 at 5 ("The Cisco IOS CLI has essentially become the standard for configuration in the networking industry."); ARISTANDCA00009488 at 1 (Cisco's

[34] See http://www.cisco.com/c/en/us/training-events/training-certifications/overview.html [redacted]

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Nexus uses "the industry-standard Cisco IOS CLI to minimize the amount of time needed for operators to learn the system and become operationally proficient."); ARISTANDCA00009534 at 12 (Cisco public presentation mentioning "[i]ndustry standard CLI"); ARISTANDCA00010590 at 1 ("Cisco NX-OS offers the same industry-standard command-line environment…."); CSI-ANI-00123088 at 42 ("the industry standard Cisco-IOS Software Command-Line Interface"); [redacted]; ARISTANDCA00009519; ARISTANDCA00009527; ARISTANDCA0009621; ARISTANDCA00009651; ARISTANDCA00010430; ARISTANDCA00010513; ARISTANDCA00010605; ARISTANDCA00010675; ARISTANDCA00010689; CSI-ANI-00123091; U.S. Patent No. 7,953,886 at 1:19-23.

125. [redacted]

I. Arista EOS

126. In 2004, Arista Networks was founded[36] and shortly thereafter began developing high-speed switches aimed at the data center environment. The network operating system for Arista products was built on top of Linux, saving the authors from having to write an operating system from scratch and affording Arista users a familiar and highly-extensible environment. The resulting network operating system is called "EOS" or "Extensible Operating System." EOS provides a CLI among other interfaces through which users can configure and monitor an Arista switch. For example, in addition to the EOS CLI, EOS provides a Linux "Bash shell" for accessing the underlying Linux operating system and extensions. The Bash shell is accessible in all command modes except EXEC. But the "bash shell" does not provide access to the majority of features available in EOS, and so is not an alternative to the EOS CLI.

127. The EOS CLI is often referred to as an "industry standard" CLI because some of the more common CLI commands, widely supported by most networking vendors, are supported by EOS. Arista EOS sometimes accepts more convenient forms of these commands that accomplish the same thing, but often accepts the "standard" command as well, presumably to allow an easier learning experience for engineers already familiar with the industry-standard CLI.

128. Arista EOS is fundamentally different from every other network operating system, and in particular different from Cisco IOS. The differences range from fundamentally different architecture and operation of the operating system from

[36] From 2004-2008 it was called "Arastra Networks."

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traditional operating systems, to numerous innovative features.[37] I touch upon some of them in more detail below. First, EOS is written on top of Linux. While some Cisco IOS variants are Linux-based[38] its mainline IOS product is not. I understand that Arista uses a Linux kernel that is largely unaltered (from the open-source version) and exposes the underlying Linux environment to the user. This approach provides great stability, since the Linux kernel has been time-tested in years of open-source improvements and refinements.

129. Access to this environment opens up endless possibilities for customization and extension. Linux is a free open-source operating system with a rich set of features evolved over a long development effort. Arista saw the potential in using Linux as their underlying operating system, and adopted it in the first version of EOS and every version since.

130. Linux has a large support base, enabling a developer to find free software already designed to run on Linux. It also has management facilities that enable common chores to be carried out with ease. EOS provides a Linux "Bash shell" for accessing the underlying Linux operating system and extensions. The Bash shell is accessible in all command modes except EXEC.[39]

131. For example, using Arista's bash facility, a developer could extend EOS to trace network traffic on the switch (with "tcpdump"), run a periodic chore every night at 2am (using "cron") and send an email if a monitoring script finds something amiss (using

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[37] *See e.g.*, http://www.arista.com/assets/data/pdf/EOSWhitepaper.pdf (CSI-CLI-00022947)..
[38] IOS XE and Cisco's NX-OS; *see* http://www.cisco.com/c/en/us/products/ios-nx-os-software/nx-os/index.html
[39] But the "bash shell" does not provide access to the majority of features available in EOS, and so is not an alternative to the EOS CLI.

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"mail"). None of this is possible with a traditional Cisco IOS environment.

132. [redacted] EOS is written in Python, C++ and TACC. The Arista CLI parser specifically is written exclusively in Python, [redacted].

133. As of 2015, Arista's EOS contained over 8 million lines of source code. *See* CSI-CLI-00356303 (Arista White Paper) ("Our core innovation has been to build a better network operating system, Arista EOS (Extensible Operating System) ™, which we have built from the ground up using innovations in core technologies since our founding in 2004. We now have more than 8 million lines of code and over 1000 man-years of advanced distributed systems software engineering in our operating system."); *see also* Rebuttal Witness Statement of Kenneth Duda, Ph.D (Aug.3, 2015) at Page 24 ("Today, in version 4.15.0 of EOS, … EOS as a whole is approximately 8 million lines of code.") (ARISTANDCA00043891).

134. EOS uses an innovative and flexible architecture I have not seen used in other Network Operating Systems. EOS uses a "publish/subscribe" model whereby a **central system database** (named "SysDB" in the image below) manages all configuration data for a given network device and other running programs (called "agents") register with the central database to indicate the nature of their participation. Arista depicts their architecture by showing the central database as a central large circle with the agents as small circles around the perimeter with lines connecting them to the

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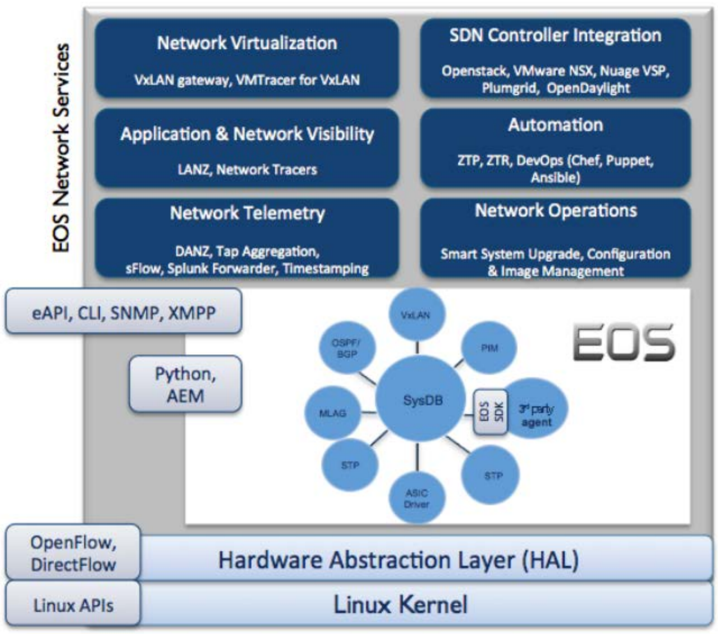
central database. This is to indicate that the agents interact only through the central database and do not interact directly with one another.[40]



135. Note that one of the agents in the figure is denoted “3rd party agent” indicating that a sophisticated Arista customer would be able to write an agent that would interact with the central database in a manner similar to existing agents, and thereby extend EOS in virtually any manner desired. I am not aware of any similar extensibility feature in any of Cisco’s operating systems, at least not those that preceded EOS. As Arista explains: “EOS offers the ability to write scripts and load applications directly onto the Linux operating system and to run these applications as guest VMs. . . . Programmable at all layers: Linux kernel, hardware forwarding tables, switch configuration and CLI, switch control plane as well as management layer”[41]

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[40] [redacted] http://www.arista.com/en/products/eos/open-and-programmable. *See also*

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136. The principle benefit of the architecture employed by EOS is resilience: if one of the agents crashes, the other agents can continue to operate and all state information is still preserved within the central database and therefore recovering from the crash is as simple as restarting the failed agent.[42] Arista EOS has a program called "ProcMgr" that periodically verifies the health of all agents on the system and restarts any agent that has failed. This "fault isolation" and "self-healing" behavior is in contrast to other Network Operating Systems which are often constructed as one large monolithic do-or-die program, where a crash in any one part means the entire operating system crashes and must be restarted, causing the device to cease functioning until the restart is complete.

137. Former Cisco engineer Devadas Patil, a Cisco engineer who worked on Cisco IOS for more than a decade and was very familiar with the Cisco IOS architecture, came to the same conclusion about Arista's EOS. In 2007 or 2008, while he was still an engineer at Cisco, Mr. Patil personally researched the Arista EOS product and concluded from that research that Arista had "created a non-monolithic switching operating system, which is very resilient and highly—highly available and performs at an impressive metrics level[.]" Patil Dep. Tr. at 104-106. As Mr. Patil further explained, "non-monolithic" is "a design term where we—we have definite—or we consider processes or individual feature sets as disparate units inside of a platform; whereby, if things were to go wrong in one process, it does not affect the rest of the platform, and that—that

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http://www.arista.com/assets/data/pdf/EOS_Extensibility_AAG.pdf.

[42] http://www.arista.com/en/products/eos/resiliency. This architecture allows for features such as software fault containment, in-service software patches and in service software upgrades. *Id.* This contributes to high availability--the device need not be shut down for most maintenance. *See, e.g.,* http://www.arista.com/en/products/eos.

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particular process that went wrong could be restarted within a few microseconds and nobody would notice the difference." *Id.* at 105.

138. Mr. Patil also wrote a thesis for his master's degree obtained from MIT, which was published publicly in 2011 and based on six months of research, that extolled the technical innovations of Arista EOS, many of which I agree with.[43] In Mr. Patil's thesis, which he confirmed to be accurate and based upon over a decade's worth of engineering experience and expertise regarding the architecture of Cisco IOS, he stated:

> To meet the networking demands of cloud computing, ... the network needs to be scalable and should provide low latency and high resiliency. The creation of such a high performance underlying network constitutes cloud networking. In addition to the general network attributes mentioned above, the network needs to also provide predictable performance and extensible management. In order to deliver such performance, some companies are looking at new approaches in design and architecture. Arista Networks' Extensible Operation System (EOS) is an example of innovation in this area. Arista EOS architecture is based on a new paradigm where the state and the process are maintained separately.[44]

I agree with Mr. Patil's assessment that Arista EOS is an example of innovation and a

[43] *See* Patil Dep. Tr. 50-54, 107 to 114; Ex. 314.
[44] Patil Dep. Tr. 107 to 114; Ex. 314.

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"new paradigm" of design and architecture, particularly in view of Cisco's IOS architecture, with which Mr. Patil had over a decade of experience as an engineer at Cisco.

139. To my knowledge, Cisco does not publish the internal architecture of any of its IOS versions or variants, so I cannot be certain of Cisco's architecture, but I would be very surprised to learn that it does what Arista's does: I have never seen Cisco literature touting similar features to those just enumerated above, and the limited view I had when reviewing one version of IOS gave me the impression that IOS is implemented as one monolithic process and not partitioned into isolated agents, as EOS is.

140. Beyond these fundamental differences in EOS just given, EOS adds several features unique in the networking devices domain. Many of Arista's products offer high-granularity logging via its LANZ technology, allowing analysis of latency issues common in high-speed network environments.[45] LANZ is transformative technology: a common problem in high-speed networks is congestion and packet loss. In many settings, network traffic occurs in "bursts" often lasting for very short periods, but with a volume of network traffic so large that the switch is unable to hold all of the arriving packets in its buffer. This means the switch will then drop packets, with a resulting degradation in network performance.

141. Traditionally, network engineers had to rely on older monitoring technology such as RMON or SNMP. But these technologies often reported coarse-grain statistics (measuring buffers once every 30 seconds or more) and would miss the intense

[45] See, e.g., CSI-CLI-00020565 (Arista 7500 DataSheet listing this feature); CSI-CLI-00022947 (Arista White Paper entitled "EOS: The Next Generation Extensible Operating System"). This details and level of support for LANZ depend on the chipset used in the switch. This is one of Arista's several features that contribute to greater visibility into the network. http://www.arista.com/en/products/eos/visibility.

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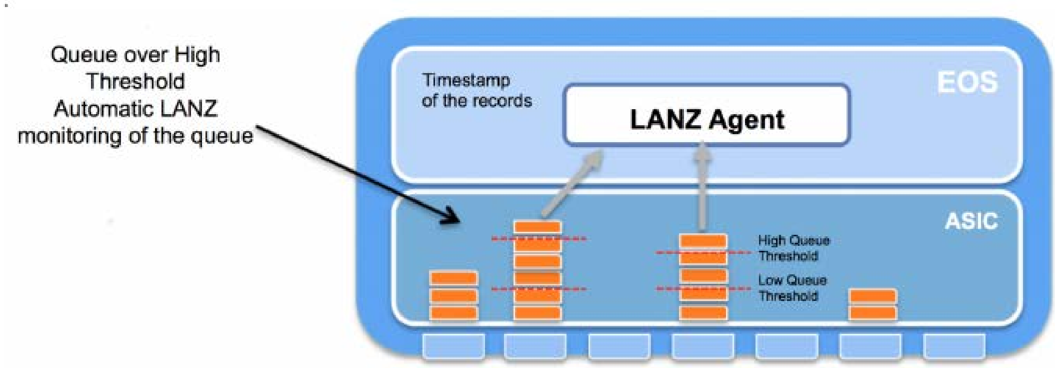
"microbursts." *See, e.g.*, Berly Dep. Tr. 104:2-105:11 (discussing the LANZ feature). LANZ allows a user to capture queuing statistics with *microsecond* granularity, allowing a user to troubleshoot problems after the fact using reports generated by the switch, and allowing a user to set alerts that foresee problems before they arise. *Id.*; *see also* CSI-CLI-00357036 (Arista 7150S Q&A Document discussing the LANZ feature). Because of the extensibility and customization facilities provided in EOS, a user can use LANZ to monitor queuing statistics within the switching fabric, and then report them to an agent or script running within EOS. That agent can report an alert to an operator, or may even dynamically reallocate traffic to another less-congested port.

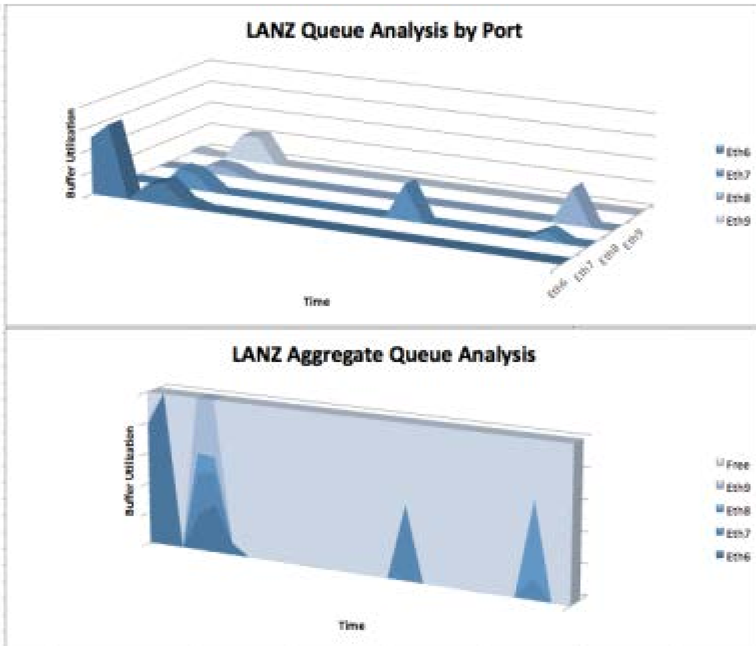


142. For example, in the picture above taken from an article entitled "Latency Analyzer (LANZ) Architectures and Configuration" on the publicly accessible "EOS Central" section of Arista's website, the ASIC is set with a "low queue" threshold and a "high queue" threshold. *See* https://eos.arista.com/latency-analyzer-lanz-architectures-and-configuration (attached as **Exhibit 3**). It then reports queuing statistics to the LANZ Agent with timestamps indicating buffer levels with microsecond granularity, if threshold levels are exceeded. EOS supports "show" commands that enable an operator to examine these statistics, or they can be written to a log file, or they can be sent to a remote

monitoring system using GPBs (Google Protocol Buffers).

143. Enabling LANZ is done via EOS CLI extensions unique to Arista; LANZ CLI commands contain the queue-monitor keyword. For example, to enable LANZ, the operator would issue the CLI command "queue-monitor length" in global configuration mode. Thresholds for high and low queue levels are set with a command such as "queue-monitor length global-buffers thresholds 1000 500". To then see a report on queuing levels from the EOS CLI, the operator would issue a command such as "show queue-monitor length status". This command would generate a report showing queue statistics in periods where thresholds were exceeded, the length of queues, buffer sizes, etc. The details of this report vary depending on the model of Arista switch used.

144. EOS supports the "show queue-monitor length csv" as well, which causes the switch to generate a CSV (Comma-Separated Values) file that can be imported into Microsoft Excel or similar tools for further analysis. EOS supports the "queue-monitor streaming" command, which causes the switch to open port 50001 and enable a GPB client to connect and pull down LANZ records for remote monitoring. Once collected, these statistics could be used to generate graphs that demonstrate where oversubscription or congestion problems reside, as shown in the illustration below from an Arista Technical Bulletin entitled "LANZ - A New Dimension in Network Visibility, which was produced Cisco's files in this lawsuit (CSI-CLI-00357104) and is available for downloading from Arista's website at https://www.arista.com/assets/data/pdf/TechBulletins/Lanz.pdf:



145. In the figure above, we see that the Ethernet port called "Eth6" experienced a spike in traffic early on, and then just after this, all ports (Eth6, Eth7 Eth8 and Eth9) all experienced a mild burst of traffic simultaneously. *See* CSI-CLI-00357104.

146. Arista implemented LANZ because in certain environments such as cluster-based high-performance computing or high-frequency trading[46] applications network congestion commonly occurs and is very hard to detect and correct with traditional monitoring tools. By being first-to-market with this technology, Arista provided a facility that set it apart from other switch vendors and further distinguished its products in demanding high-performance data-center environments.

147. EOS also supports "Zero Touch Provisioning" or "**ZTP**" which allows an Arista switch to obtain its configuration automatically upon start-up.[47] . EOS also fully

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[46] High-Frequency Trading is a practice where financial instruments are traded based on proprietary algorithms that react in fractions of a second to market conditions. Very high performance networking equipment is critical in these settings.
[47] *See* ARISTANDCA00079230 ("ZTP basic setup guide" located on the Arista EOS Central website, also

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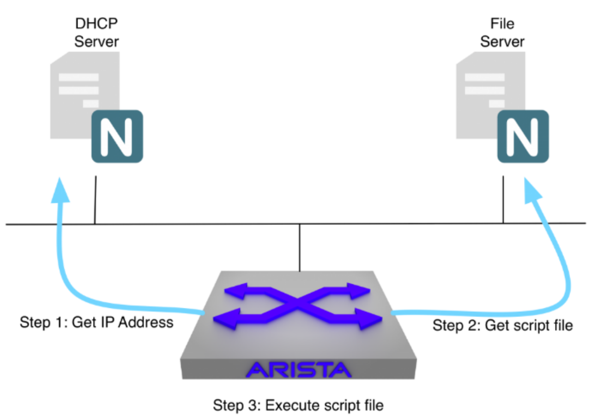
leverages the underlying Linux operating system to allow familiar tasks like cron jobs, emails, system monitors, etc., to be added if desired. *See id.*

148. ZTP leverages well-known and long-established protocols as part of its operation. One of these old protocols is called DHCP (for "Dynamic Host Configuration Protocol"). DHCP is ubiquitous: it runs in your smartphone, your laptop, your home wi-fi router, etc., and also runs in enterprise, campus, and service-provider environments. When your laptop (for example) first connects to a wireless network, it broadcasts a DHCP request to get an IP address for that network. A "DHCP server" responds with configuration information including the temporarily-assigned IP address for your laptop for the duration of the "lease" granted to it. What Arista realized was that it could use DHCP with its switches to not only obtain an IP address, but also to receive a link to a configuration file. This link would typically point to a "file server" that would facilitate download of the configuration parameters or to a configuration script that would be run on the switch.



ARISTANDCA00079230 ("ZTP basic setup guide" located on the Arista EOS Central

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available at https://eos.arista.com/ztp-set-up-guide/). *See also* http://www.arista.com/en/products/eos/eos-applications.

website, also available at https://eos.arista.com/ztp-set-up-guide/).

149. Using this approach, an Arista switch can initialize itself without user intervention. *See* ARISTANDCA00079230 ("ZTP basic setup guide" located on the Arista EOS Central website, also available at https://eos.arista.com/ztp-set-up-guide/). Provided the DHCP server and file server were already installed on the network, a new Arista switch could be mounted in a rack, plugged into the network, and powered up, and then ZTP would take over from there, supplying the switch with its configuration parameters automatically. This is a simple yet powerful idea that reduces the amount of labor required by human operators and relegates configuration to a central point of control.

150. ZTP is enabled by default. If an Arista switch does not have a configuration file available, and it cannot obtain its configuration from ZTP, it will not come into an operational state. ARISTANDCA00079230 ("ZTP basic setup guide" located on the Arista EOS Central website, also available at https://eos.arista.com/ztp-set-up-guide/). ZTP can be used to perform other tasks beyond just configuration. For example, new EOS updates can be downloaded and installed using the ZTP mechanism. *Id.*

151. EOS also offers **eAPI** technology to support centralized management of its switches. *See id.*; *see also* CSI-CLI-00355210 (Arista White Paper entitled "Arista Cloud Networks"); CSI-CLI-00022934 ("Arista-at-a-Glance" document entitled "CloudVision™: Single Point of Administration and Management").

152. eAPI is a facility introduced in EOS version 4.12 that allows programmatic management of a switch via HTTP. In other words, as an alternative to

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connecting to a switch with telnet or ssh and then issuing CLI commands, an operator can use a program (written in virtually any language she or he chooses) usually running on some off-switch machine, and it can connect to the switch and issue commands packaged in "JSON" format over a protocol known as HTTP[48]. This is a powerful idea for the following reasons: (1) Allowing remote programmatic control of a switch allows centralized management of a data center rather than relying on the old method of downloading CLI configuration scripts to each device individually or relying on a human operator to manage a switch manually using its CLI. (2) HTTP is a widely supported protocol and therefore many programming libraries will support it without much effort by the developer, and most developers are already familiar with how to implement and use HTTP. (3) JSON is a common and widely-used data format and there are many libraries that support packaging and parsing data in JSON. All of these facts taken together mean that a competent developer can put together a program to remotely control an Arista switch with little effort.

153. eAPI is not enabled by default, but can be enabled with the command "management api http-commands" issued from privileged exec mode. This invokes the eAPI mode and its associated prompt. Then "protocol http" and "no shutdown" start the service. Using the Arista 7048 in my possession, I was able to issue these commands and then send and receive JSON with about 10 minute's work.

154. As an example, suppose we wanted to send both the "show version" and "show hostname" CLI commands over the eAPI interface. The JSON request might look like this:

[48] eAPI additionally supports HTTPS, which is the more secure version of HTTP that incorporates encryption and authentication

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See **Exhibit 4** ("Arista eAPI 101" Article from the "EOS Central" portion of the Arista public webiste, available at https://eos.arista.com/arista-eapi-101/.

155. The data above are depicted in JSON format: the outer braces enclose the request and within them each attribute of the request is named in quotes, followed by a colon, followed by the value corresponding to that attribute. The attribute called "cmds" is an array that lists the two CLI commands issued in the request. The data shown above are then sent over HTTP or HTTPS and received by the eAPI facility of EOS running on the switch. EOS then parses each CLI request in turn and formats each response as JSON, then transmits that response over the same HTTP or HTTPS connection where the request was issued. A response to the two CLI commands shown above might look like this:

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```
{
  "jsonrpc": "2.0",
  "result": [
    {
      "modelName": "vEOS",
      "internalVersion": "4.14.5F-2208015.4145F",
      "systemMacAddress": "08:00:27:0e:bf:31",
      "serialNumber": "",
      "memTotal": 2028800,
      "bootupTimestamp": 1418722057.28,
      "memFree": 264300,
      "version": "4.14.5F",
      "architecture": "i386",
      "internalBuildId": "34f48cf0-e8b0-4c86-96ce-f032ddcccdd0",
      "hardwareRevision": ""
    },
    {
      "fqdn": "myswitch",
      "hostname": "myswitch"
    }
  ],
  "id": "CapiExplorer-123"
}
```


See **Exhibit 4** ("Arista eAPI 101" Article from the "EOS Central" portion of the Arista public webiste, available at https://eos.arista.com/arista-eapi-101/).

156. The "result" array here contains first the result of the "show version" CLI command, then the result of the "show hostname" CLI command. Rather than just wrapping the entire response as it would have appeared when using the CLI directly, eAPI formats the response into JSON, tagging each data element with a descriptive attribute. This facilitates easy parsing on the receiving end, and makes programmatic control of Arista switches quite straightforward.

157. Arista also supports **VM Tracer**, an EOS tool used to manage virtualized environments.[49] A "physical machine" is a tangible computer. A "virtual machine" is a computer that exists only in software, but acts just like a physical computer to the

[49] *See, e.g.*, CSI-CLI-00020565 (Arista 7500 DataSheet listing this feature); CSI-CLI-00022947 (Arista White Paper entitled "EOS: The Next Generation Extensible Operating System"); CSI-CLI-00356065 (Arista White Paper entitled "Solving the Virtualization Conundrum"). *See also, e.g.*, Berly Dep. Tr. at 104-117.

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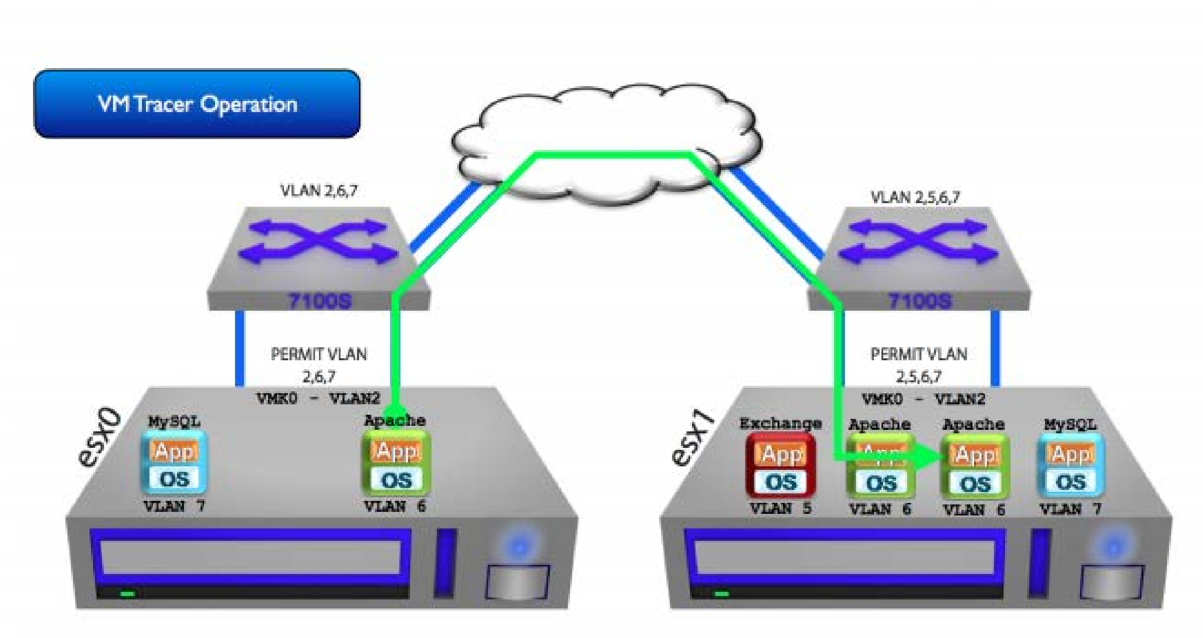
software running on it and to the environment around it. Virtual machines were largely unheard of in the commercial domain just 10 years ago and now, in concert with Cloud Computing, have revolutionized how computing is done. A large physical computer can be "carved up" into many virtual machines, allowing the sharing of the physical resources between them. This facilitates a business model whereby large cloud providers (eg, Amazon, Microsoft, Google, etc.) can provide a virtual machine, often on a short-term basis, to customers, and customers can run their businesses on an infrastructure they need not own, maintain, repair, upgrade, apply security patches to, etc. Moreover, a business's computing needs can grow alongside the business itself by simply purchasing more computing from the cloud provider.

158. Some businesses prefer to forgo using a cloud provider and instead manage their own data center "on premises." This is often done for compliance reasons or security reasons. In this case, there are still advantages to using a virtualized environment as just described. However, configuring and managing this environment can be quite complex and many operators find the management and troubleshooting of a medium-sized virtualized environment challenging.

159. The preeminent company in the commercial virtualization market is VMWare. VMWare makes and sells software that facilitates hosting, managing and maintaining virtual machines in environments from the desktop to the data center. In the latter setting, VMWare sells a product called ESX. Arista has a complementary product called "VM Tracer" that helps to manage the complex environment involved in hosting and tracking the network connections for various virtual machines under ESX.



160. In the figure above, which comes from the "Arista VM Tracer - unprecedented visibility" document available on Arista's public website, two physical machines are running ESX; one is named esx0 and the other is named esx1. *See* **Exhibit 5** (attaching the document at https://www.arista.com/assets/data/pdf/TechBulletins/VMTracerOverview.pdf). On esx0 there are two virtual machines and on esx1 there are four. Two Arista 7100S switches are shown, one connected to each physical machine and connected to each other over a network (depicted by the cloud). The green arrow is indicating that the virtual machine for Apache on VLAN 6 is migrating to the other physical host. Amazingly, modern virtualization technology allows this to be done without shutting down the virtual machine: it can be moved while it's still running! The migration is done by VMWare, but Arista's VM Tracer feature allows easy tracking of the migrated VM along with other information including port information, version and status for the virtual machines on a

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given port, and can create or delete VLANs as needed automatically.[50]

161. [redacted]

162. Arista also took notice that Cisco had added support for several features that EOS first supported, including "cloning" Arista's ZTP with Cisco's POAP, and also adding Python API features. *See, e.g.*, ARISTANDCA00124531 (Arista emails commenting on "new" NX-OS features that replicated Arista EOS features).

163. Some of the 514 commands (and command fragments) that Cisco accuses Arista of copying are syntactically similar to commands accepted by the Arista CLI. But the similarity ends there: what the Arista device actually *does* with the command often varies. For example, consider the "max-connections" command.[51] In an Arista device,

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[50] In addition to LANZ and VMTracer, Arista's EOS offers other tools to improve monitoring and visibility into the network such as Health Tracer, Path Tracer and Map Reduce Tracer. *See* http://www.arista.com/assets/data/pdf/Whitepapers/Simplifying_Network_Operations_Data_Center_Automation_Whitepaper.pdf.

[51] As pointed out elsewhere in this Report, "max-connections" is a command claimed by Cisco but I have been unable to find any documentation of this command in any Cisco reference for any version of IOS or its variants. Moreover, in Arista's usage, "max-connections" is not a "command" but rather a command prefix, since it must be followed by an integer to be valid.

"max-connections" sets the maximum number of incoming connections from clients who wish to monitor the LANZ data produced by the switch. For example, if the operator types "max-connections 10" then at most 10 external computers can connect to the LANZ port to retrieve latency data using GPBs as described above. Clearly whatever Cisco uses this command for cannot be the same: Cisco does not implement LANZ. Cisco does have a similar feature to LANZ on some of their Nexus switches, but that technology came *after* Arista introduced LANZ. If Cisco uses "max-connections" in the same way Arista does, it is not Arista who copied the command. Therefore Arista's use of "max-connections" is (if borrowed at all) for a completely different purpose.

164. As a second example, consider "ip protocol" which Cisco uses to configure an old tunneling technology called L2TP[52]. Although Arista has a command that starts with the same two words, and is followed by "udp" or "tcp", as the Cisco command also allows, it is used by Arista for a completely different purpose: an Arista device interprets this command as giving the transport protocol for their "Monitor Reachability Probe Transmitter" feature, which is unique to Arista. Indeed, the Arista command is entered in a mode invoked by the Arista CLI command "monitor reachability" which is not a valid Cisco IOS command. The Arista "monitor reachability" command changes the CLI's mode to a mode not available in Cisco products, and only then is the "ip protocol" command prefix used:

```
switch(config)#monitor reachability
switch(config-mon-reach)#probe transmitter PROBE-X
switch(config-mr-trans-PROBE-X)#ip protocol tcp
```

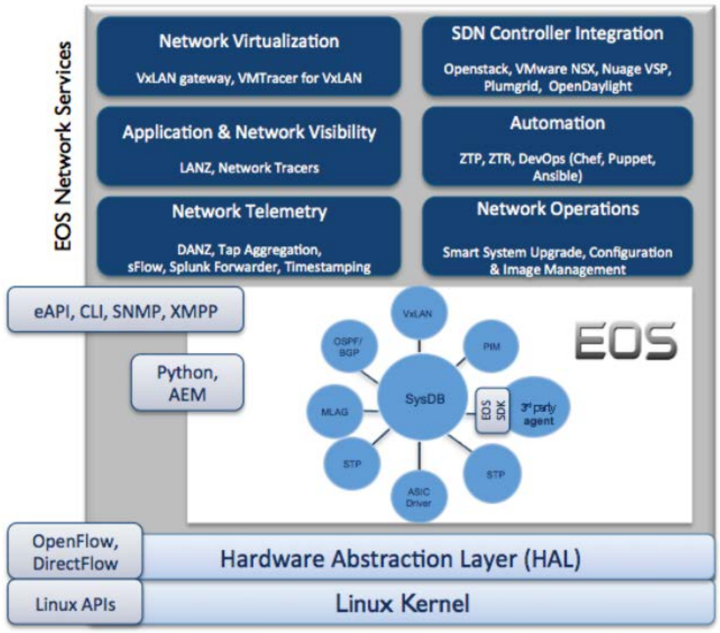
[See CSI-CLI-06302874 at Page 2133] (Arista Networks User Manual for Arista EOS

[52] Once again, "ip protocol" cannot be entered as is and therefore is not an IOS "command" but the prefix of a command. *See* CSI-CLI-00344775 at WAN-250.

v.4.15.3F).

165. Even in cases where a Cisco IOS command produces the same net effect from the user's perspective, the Arista implementation is quite different, in part at least because of the architectural differences described above. For example, consider the well-known and widely-used spanning tree protocol or ("STP"). This protocol was defined more than 25 years ago by the IEEE (see **Appendix B**) and is used to prevent layer 2 forwarding loops[53]. Cisco accuses Arista of copying several commands related to this functionality such as "show spanning-tree", "spanning-tree cost", "spanning-tree vlan", etc. While it is true Arista supports commands similar to those accused, it transforms those commands into something quite different by virtue of its different software architecture as discussed above: EOS uses isolated agents which in turn communicate with a central database using a publish/subscribe model. EOS implements its STP functionality via a dedicated STP agent indicated by the circle below containing its name:

[53] A forwarding loop means that a data packet would be sent around in circles between switches, consuming bandwidth and never reaching its intended destination. This was a problem before the invention of STP.



166. When an operator issues a command to change STP parameters into the Arista CLI, the CLI agent parses that command and sends a message to the central database indicating the new parameters. The central database then records the changes and notifies the STP agent that its parameters have been updated. The STP agent then operates according to those settings until further changes are made. If the STP agent starts to have problems (eg, it locks up, crashes, ceases to register its heartbeat with the system), ProcMgr will kill the STP agent and restart it without any operator intervention. An old-style monolithic product simply cannot operate in this fashion, even though it may support "spanning-tree vlan"[54].

167. In short, Arista often supports important well-established command

[54] Once again "spanning-tree vlan" is only a partial command; neither the Cisco CLI nor the Arista CLI will accept this prefix without at least specifying a vlan ID. For Cisco, a single vlan ID is required, followed by a large number of optional parameters. *See* ARISTANDCA00241665 ("Cisco IOS LAN Switching Command Reference November 2010"). For Arista, a single vlan ID or a range of vlan IDs are specified and no further optional parameters are accepted. *See* CSI-CLI-06302874 at 1051 (Arista Networks User Manual for Arista EOS v.4.15.3F)

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syntaxes and protocols, but it does so via its innovative and transformative technology. An analogy is useful here: a Tesla is a completely electric vehicle, yet still has a "gas pedal". The "gas pedal" looks and feels like the same pedal from a 1975 AMC Pacer, but the action performed when you press the pedal on the Tesla is very different from what happens on the Pacer. In both cases the car would move forward, but the mechanism by which it did was distinctly different. Another example: modern digital cameras have a shutter button in the same place, with the same shape as the vintage mechanical cameras from the 1980's. Digital cameras often even make the "buzzing" sound of an autowinder when a picture is taken. But once again, even though the net effect is the same (a picture is taken) the digital camera has transformed the shutter button into something very different by virtue of what it actually does. Arista has done something analogous here: although the "pedals" and "buttons" on Arista's devices are familiar and produce the intended effect, they do so in an innovative and transformative way.[55]

168. I rely on this discussion and analysis of Arista's innovative and distinctive features and functionality, and how they contrast with Cisco's products, as part of my fair use analysis later in this Report, including in particular my discussion of transformative use in my fair use analysis. I therefore incorporate my entire discussion regarding Arista EOS from this section of my Report into the "Fair Use" section of my Report.

VII. COMMON CLI USAGE ACROSS THE NETWORKING INDUSTRY

A. Networking companies who adopted Cisco IOS-like CLIs.

169. I have reviewed documentation and materials, including materials

[55] To my knowledge, the only Cisco product that uses a Linux-based modular architecture is Cisco IOS XR 5.0, released Sep 2013, years after Arista had begun shipping EOS.

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produced by Cisco, Arista, and third-parties in this litigation, transcripts from depositions of Cisco, Arista, and third-party witnesses, and publicly-available information regarding networking companies who have adopted, and currently support, Cisco IOS-like CLIs on network devices like Ethernet switches and routers. In other words, these network devices present a Cisco IOS-like CLI to the end user of the device.

170. Later in this Report, I will also discuss two software products made and sold by Cisco that also support a Cisco IOS-like CLI and present that interface to the end user of the software. The two products are called (1) Network Services Orchestrator (or Cisco NSO) and (2) ConfD. I discuss both of those products in detail in a separate section of this Report that addresses management software for multi-vendor networks. I mentioned both of those products here, however, because both the Cisco NSO and ConfD products have adopted and support Cisco-like CLIs that they present to the end user.

171. In this Report, I may use the term “industry standard CLI” interchangeably with the phrases “Cisco IOS-like CLI,” “Cisco-like CLI,” or “IOS-like CLI.” The “industry standard CLI” refers to the common, well-known, and widely adopted features and functionality of CLIs supported across multiple vendors’ networking devices (*e.g.*, switches and routers), with which end users (*i.e.*, customers who purchase and use such devices) have become and are familiar. These common features and functionality include CLI commands, command hierarchies, command modes, command prompts, and command responses, and cover accused aspects of the Arista EOS CLI accused by Cisco in this litigation.

172. Both the Cisco IOS CLI and the Arista EOS CLI support the “industry standard CLI,” as well as numerous other networking vendors discussed in this and other

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sections of my Report.

173. The Cisco reference manuals that I reviewed and analyzed for purposes of this Report include the following publicly-available Cisco documentation that was available for download on Cisco's website as of April 2016:

i) [ARISTANDCA00234285] "Cisco IOS IP Addressing Services Command Reference"

ii) [ARISTANDCA00235463] "Cisco IOS Basic System Management Command Reference"

iii) [ARISTANDCA00235631] "Cisco IOS Configuration Fundamentals Command Reference"

iv) [ARISTANDCA00237180] "Cisco IOS IP Application Services Command Reference"

v) [ARISTANDCA00237538] "Cisco IOS IPv6 Command Reference"

vi) [ARISTANDCA00239885] "Cisco IOS IP Routing: BGP Command Reference"

vii) [ARISTANDCA00240835] "Cisco IOS IP Routing: Protocol-Independent Command Reference"

viii) [ARISTANDCA00241193] "Cisco IOS IP Switching Command Reference"

ix) [ARISTANDCA00241665] "Cisco IOS LAN Switching Command Reference"

x) [ARISTANDCA00242110] "Cisco IOS SNMP Support Command

Reference"

xi) [ARISTANDCA00242590] "Cisco IOS Quality of Service Solutions Command Reference"

xii) [ARISTANDCA00243953] "Catalyst 3750-E and 3560-E Switch Command Reference"

xiii) [ARISTANDCA00245097] "Cisco Nexus 7000 Series NX-OS Fundamentals Command Reference"

xiv) [ARISTANDCA00245319] "Cisco Nexus 7000 Series NX-OS Interfaces Command Reference"

xv) [ARISTANDCA00245629] "Cisco Nexus 7000 Series NX-OS Layer 2 Switching Command Reference"

xvi) [ARISTANDCA00245835] "Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference"

xvii) [ARISTANDCA00246279] "Cisco Nexus 7000 Series NX-OS MPLS Command Reference"

xviii) [ARISTANDCA00246705] "Cisco Nexus 7000 Series NX-OS Quality of Service Command Reference"

xix) [ARISTANDCA00246861] "Cisco Nexus 7000 Series NX-OS Security Command Reference"

xx) [ARISTANDCA00247735] "Cisco Nexus 7000 Series NX-OS System Management Command Reference"

xxi) [ARISTANDCA00248619] "Cisco Nexus 7000 Series NX-OS Unicast Routing Command Reference"

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174. I have also reviewed and considered the following command reference manuals produced by Cisco in this litigation:

i) [CSI-CLI-00130522] "Cisco IOS XR Advanced System Command Reference" (Cisco IOS XR 5.2)

ii) [CSI-CLI-00131220] "Cisco IOS XR Multicast Command Reference" (Cisco IOS XR 5.2)

iii) [CSI-CLI-00131672] "Cisco IOS XR IP Addresses and Services Command Reference" (Cisco IOS XR 5.2)

iv) [CSI-CLI-00135600] "Cisco IOS XR Routing Command Reference" (Cisco IOS XR 5.2)

v) [CSI-CLI-00137630] "Cisco IOS XR System Security Command Reference" (Cisco IOS XR 5.2)

vi) [CSI-CLI-00178252] "Cisco Nexus 7000 Series NX-OS Layer 2 Switching Command Reference" (Cisco NX-OS 6.2)

vii) [CSI-CLI-00192227] "Cisco Nexus 7000 Series NX-OS Fabric Extender Command Reference" (Cisco NX-OS 6.2)

viii) [CSI-CLI-00192293] "Cisco Nexus 7000 Series NX-OS Fundamentals Command Reference" (Cisco NX-OS 6.2)

ix) [CSI-CLI-00192515] "Cisco Nexus 7000 Series NX-OS Interfaces Command Reference" (Cisco NX-OS 6.2)

x) [CSI-CLI-00192821] "Cisco Nexus 7000 Series NX-OS IP SLAs Command Reference" (Cisco NX-OS 6.2)

xi) [CSI-CLI-00193199] "Cisco Nexus 7000 Series NX-OS

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Multicast Routing Command Reference" (Cisco NX-OS 6.2)

xii) [CSI-CLI-00193647] "Cisco Nexus 7000 Series NX-OS Quality of Service Command Reference" (Cisco NX-OS 6.2)

xiii) [CSI-CLI-00194055] "Cisco Nexus 7000 Series NX-OS System Management Command Reference" (Cisco NX-OS 6.2)

xiv) [CSI-CLI-00194801] "Cisco Nexus 7000 Series NX-OS Unicast Routing Command Reference" (Cisco NX-OS 6.2)

xv) [CSI-CLI-00214393] "Cisco Nexus 7000 Series NX-OS Security Command Reference" (Cisco NX-OS 6.2)

xvi) [CSI-CLI-00220355] "Cisco IOS IP Addressing Services Command Reference" (Cisco IOS 15.4)

xvii) [CSI-CLI-00221529] "Cisco IOS IP Routing: RIP Command Reference" (Cisco IOS 15.4)

xviii) [CSI-CLI-00228225] "Cisco IOS Network Management Command Reference" (Cisco XE 3.5)

xix) [CSI-CLI-00262396] "Cisco IOS Security Command Reference: Commands D to L" (Cisco XE 3.5)

xx) [CSI-CLI-00271385] "Cisco IOS IP Multicast Command Reference" (Cisco IOS 15.0)

xxi) [CSI-CLI-00273242] "Cisco IOS Multiprotocol Label Switching Command Reference" (Cisco XE 2.1)

xxii) [CSI-CLI-00291752] "Cisco IOS Carrier Ethernet Command Reference" (Cisco IOS 15.4)

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xxiii) [CSI-CLI-00292296] "Cisco IOS IP Application Services Command Reference" (Cisco IOS 15.4)

xxiv) [CSI-CLI-00292982] "Cisco IOS IPv6 Command Reference" (Cisco IOS 15.4)

xxv) [CSI-CLI-00294972] "Cisco IOS IP Multicast Command Reference" (Cisco IOS 15.4)

xxvi) [CSI-CLI-00295948] "Cisco IOS IP Routing: Protocol-Independent Command Reference" (Cisco IOS 15.4)

xxvii) [CSI-CLI-00296282] "Cisco IOS IP Routing: OSPF Command Reference" (Cisco IOS 15.4)

xxviii) [CSI-CLI-00296590] "Cisco IOS IP Routing: EIGRP Command Reference" (Cisco IOS 15.4)

xxix) [CSI-CLI-00296906] "Cisco IOS Interface and Hardware Component Command Reference" (Cisco IOS 15.4)

xxx) [CSI-CLI-00299650] "Cisco IOS IP Routing: ISIS Command Reference" (Cisco IOS 15.4)

xxxi) [CSI-CLI-00299856] "Cisco IOS IP Routing: BGP Command Reference" (Cisco IOS 15.4)

xxxii) [CSI-CLI-00302628] "Cisco IOS Multiprotocol Label Switching Command Reference" (Cisco IOS 15.4)

xxxiii) [CSI-CLI-00304206] "Cisco IOS IP Switching Command Reference" (Cisco IOS 15.4)

xxxiv) [CSI-CLI-00304756] "Cisco IOS Security Command Reference:

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Commands M to R" (Cisco IOS 15.4)

xxxv) [CSI-CLI-00305560] "Cisco IOS Security Command Reference: Commands D to L" (Cisco IOS 15.4)

xxxvi) [CSI-CLI-00306596] "Cisco IOS Security Command Reference: Commands A to C" (Cisco IOS 15.4)

xxxvii) [CSI-CLI-00307700] "Cisco IOS Security Command Reference: Commands S to Z" (Cisco IOS 15.4)

xxxviii) [CSI-CLI-00310346] "Cisco IOS Security Command Reference: Commands S to Z" (Cisco XE 3.5)

xxxix) [CSI-CLI-00312777] "Cisco IOS Wide-Area Networking Command Reference" (Cisco XE 3.5)

xl) [CSI-CLI-00325714] "Cisco IOS Basic System Management Command Reference" (Cisco IOS 15.4)

xli) [CSI-CLI-00325922] "Cisco IOS Broadband Access Aggregation and DSL Command Reference" (Cisco IOS 15.4)

xlii) [CSI-CLI-00327560] "Cisco IOS First Hop Redundancy Protocols Command Reference" (Cisco IOS 15.4)

xliii) [CSI-CLI-00327842] "Cisco IOS SNMP Support Command Reference" (Cisco IOS 15.4)

xliv) [CSI-CLI-00328320] "Cisco IOS HTTP Services Command Reference" (Cisco IOS 15.4)

xlv) [CSI-CLI-00350066] "Cisco IOS Interface and Hardware Component Command Reference" (Cisco IOS 15.0)

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xlvi) [CSI-CLI-00531980] "Catalyst 4500 Series Switch Cisco IOS Command Reference" (IOS XE 3.3)

175. I have also reviewed and/or analyzed the Arista manuals for purposes of this Report, including the Arista User Manual for Arista EOS version 4.15.3F, dated November 20, 2015 (CSI-CLI-06302874).

176. I also used and analyzed, for purposes of this Report, Arista's vEOS software[56], which allows EOS, including the EOS CLI, to be run in a virtual machine environment. This includes using the EOS CLI to export all permutations/combinations of full commands recognized by the EOS CLI parser as an actual command.

177. I also used and analyzed, for purposes of this Report, a Cisco 3725 router, running Cisco IOS Software, 3700 Software (C3725-ADVENTERPRISEK9-M), Version 12.4(9)T, RELEASE SOFTWARE (fc1). I note, however, that the CLI commands "show parser dump all" and "show parser dump configure" do not work properly on the Cisco router in my possession, and would cause the OS to crash before exporting all permutations and combinations of full commands recognized by the Cisco IOS CLI parser as an actual command.

B. Summary of Opinions on Common CLI Usage

178. As shown in this section of my Report, it is my opinion the accused command modes and prompts (listed in Exhibit C to Cisco's Interrogatory Responses) are supported by the vast majority of networking equipment vendors I examined for this Report, and that the disputed command modes and prompts are part of the industry-standard CLI that users of networking equipment expect.

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[56] I used Arista vEOS 4.15.5M-3054042.4155M

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179. A summary chart of my analysis and opinions regarding the common usage and adoption across the networking industry of the accused command modes and prompts in this litigation is provided in **Appendix C**.

180. It is also my opinion that many third-party networking vendors that sell switches and routers (or who sold switches and routers before being acquired or ceasing operations) supported and still support hundreds of the same disputed CLI commands at issue in this case. Based on my analysis of user documentation for many third-party networking equipment vendors:

i) Dell's CLI for its networking products has supported more than half of the disputed CLI commands in this lawsuit. At least 268 of the accused CLI commands (or command fragments) are found in Dell and Force10 command reference manuals.

ii) At least 268 of the accused CLI commands (or command fragments) are found in Brocade's command reference manuals for its networking products.

iii) At least 218 of the accused CLI commands (or command fragments) are found in Juniper's command reference manuals for its JUNOSe (E-Series) line of networking products.

iv) At least 163 of the accused CLI commands (or command fragments) are found in Foundry Networks' command reference manuals for its networking products (Foundry was acquired by Brocade, and no longer exists).

v) Over 300 of the accused CLI commands (or command fragments)

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are found in D-Link's command reference manuals for its networking products.

vi) At least 223 of the accused CLI commands (or command fragments) are found in Edge-Core's command reference manuals for its networking products.

vii) Several other vendors, including HP, Extreme Networks, Alcatel (and ALU), Lenovo/IBM/BNT (all of whom use the "Industry Standard CLI" or ISCLI), Oracle/Sun, NETGEAR, Procket Networks, and Adtran show in their documentation that they support well over 100 of the accused CLI commands (or command fragments) each.

181. Beyond the commands and command fragments that Cisco selected for this lawsuit against Arista, I have also counted at least 1,600 unique and syntactically complete CLI commands supported by the Dell and Force10 CLIs that overlap with Cisco IOS commands. Therefore, the Dell CLI alone supports at least 1600 distinct CLI commands that are also supported by the Cisco CLI. This count is based on ***exact*** matches between the Dell CLI and Cisco CLI command sets.

182. Since Cisco's disputed commands (and command fragments) in this lawsuit ignore identifiers in the asserted Cisco commands as well as the accused EOS CLI commands (Exhibit 1 to the Second Amended Complaint does not include command identifiers), and several of the accused Arista EOS CLI commands are facially different syntactically from the asserted Cisco IOS CLI commands, the count of 1,600 overlapping Dell and Cisco CLI commands is a conservative number as compared with 514

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commands and command fragments allegedly copied by Arista—and lower than it would be if CLI command identifiers were ignored, and "close matches" were taken into account.

183. Regarding the command hierarchies asserted by Cisco, the vast majority of the asserted "hierarchies" are also supported across the networking industry. For example, when you include both Cisco and Arista, at least ***twenty*** networking vendors I analyzed support (or for companies that were acquired, supported) CLI commands that start with the keywords "clear", "enable", "interface", "ip", and "show".

184. At least ***eighteen*** networking vendors, including Cisco and Arista, support (or for companies that were acquired, supported) CLI commands that start with the keywords "network", "no", "snmp-server", "area", "ipv6", "router", "timers", and "vlan". At least ***fifteen*** networking vendors, including Cisco and Arista, support (or for companies that were acquired, supported) CLI commands that start with the keywords "arp", "boot", "clock", "logging", "service", "lacp", "neighbor", "radius-server", "router-id", "tacacs-server", "terminal", "username", "aaa", "banner", "distance", "dot1x", "lldp", "mac", and "route-map".

185. And at least ***ten*** networking vendors, including Cisco and Arista, support (or for companies that were acquired, supported) CLI commands that start with the keywords "default-information", "switchport", "default-metric", "erase", "flowcontrol", "maximum-paths", "ntp", "snmp", "address-family", "aggregate-address", "channel-group", "port-channel", "class-map", "policy-map", "storm-control", "bgp", "passive-interface", "private-vlan", and "vrrp". All of these terms—as shown by their widespread adoption as root (*i.e.*, starting) CLI command keywords, are commonly known, accepted,

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and industry standard or familiar terms that CLI users expect to be supported by an industry-standard CLI. In fact, all but two accused CLI commands are used by at least one other vendor as a root command keyword.

186. A summary of the substantial overlap for command hierarchies when examining the first command keyword of the asserted CLI commands in this litigation is provided in **Appendix D**. And a snapshot of the substantial overlap for command hierarchies when examining the first two words of the asserted CLI commands is provided in **Appendix E,** which focuses on the most widely used starting two-word command keywords and does not cover all two-word combinations.

187. As shown in **Appendix E**, at least ***fifteen*** vendors, including Cisco and Arista, support families (or hierarchies) of CLI commands that start with the keywords "clear ip", "ip address", "ip dhcp", "ip igmp", "ip ospf", "ip rip", "ip route", "no snmp-server", "show arp", "show clock", "show interfaces", "show ip", "show ipv6", "show spanning-tree", "show users", "show vlan", "snmp-server community", "snmp-server contact", "snmp-server enable", and "snmp-server location."

188. And at least ***ten*** different vendors, not including Cisco and Arista, support families (or hierarchies) of CLI commands that start with the keywords "aaa accounting", "aaa authentication", "arp timeout", "boot system", "clear arp-cache", "clear counters", "clear ipv6", "clock set", "clock timezone", "default-information originate", "interface vlan", "ip access-group", "ip access-list", "ip http", "ip icmp", "ip name-server", "ip pim", "ip proxy-arp", "ipv6 access-list", "ipv6 address", "ipv6 nd", "ipv6 neighbor", "ipv6 ospf", "ipv6 route", "mac access-group", "radius-server key", "radius-server retransmit", "radius-server timeout", "router ospf", "router rip", "show dot1x", "show

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hosts", "show lacp", "show lldp", "show mac-address-table", "show qos", "show radius", "show route-map", "show snmp", "show tacacs", "show version", "snmp trap", "snmp-server group", "snmp-server host", "snmp-server user", "snmp-server view", "spanning-tree link-type", "spanning-tree mode", "switchport mode", "tacacs-server host", "tacacs-server key", "tacacs-server timeout." Additional widely used starting two-word command keywords are shown in **Appendix E**.

189. In addition, I have provided a separate list of widely used starting two-word command keywords in **Appendix F**, focusing on those supported by at least five vendors in addition to Cisco and Arista.

190. I note that my comparison of the first two command keywords between different vendors' command sets, as shown in **Appendices E and F**, will ***undercount*** the overlap between the Cisco IOS command set and other vendors. This is because the comparison algorithm I used for this particular comparison does not remove CLI command identifiers from the command syntaxes extracted from Cisco's user manuals and third-party vendor user manuals. Therefore, a CLI command like "neighbor peer-group" (which is one of the disputed commands) will instead be seen and used in the comparison algorithm as "neighbor *peer-group-name* peer-group" where "*peer-group-name*" is a CLI command identifier. Therefore, the "neighbor" family of commands will ***not*** properly match in this first two command words analysis, and will be undercounted. Any CLI command where an identifier (like "peer-group-name" above) is used after the first command keyword will not properly match in this particular analysis, and will be undercounted.

191. With respect to the disputed CLI commands, I also provide a summary of

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the most widely adopted CLI commands in **Appendix G**.

192. With respect to the disputed CLI command responses, as I discuss further in this Report, those asserted responses consist of descriptive phrases regarding switch features and functionality. The substance of the phrases derive from the functionality of the device and industry terminology used to define that functionality, which can be seen from a review of the many exemplary command responses shown in the third-party vendor manuals I analyzed for this Report.

193. Finally, I provided an analysis of the amount of CLI command overlap between certain vendors as of the 2003-2004 time period (to the extent that I have command reference manuals for such vendors), to put into context the state of the networking industry as of the Cisco vs. Huawei lawsuit. In particular, I show that CLIs used by Dell, Force10, Juniper, and Procket Networks openly supported hundreds of Cisco IOS CLI commands in the 2003-2004 time period.

194. I emphasize that the overlap between the disputed Cisco command set and third-party vendors must be viewed in context with the fact that different vendors may not support the same functionality in their respective devices. For example, some vendors may not support certain functionality—and therefore may not have any CLI commands—for VRRP, while others may. And a vendor may support OSPF version 2 but not version 3. I note this because there are instances where a vendor may use a command syntax for OSPF version 2, but may not use that command syntax for OSPF version 3 because it is not supported by the device (the disputed commands and command fragments include duplicates where the exact same command syntax is applied to different versions of OSPF).

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195. There are also instances where vendors may use the exact same disputed command syntax, but they use it for a different routing protocol. For example, Redback Networks supported a "default-information originate" CLI command for RIP, but not for OSPF. This is similar to Cisco's accusations regarding commands like "ip protocol", where Arista's use of that command syntax applies to a completely different functionality than Cisco's CLI uses that command syntax. I generally do ***not*** count those as matches between Cisco and another vendor, unless I expressly state otherwise.

196. These are just a few examples, but the bottom line is that vendors may not use overlapping commands with the Cisco IOS CLI because the devices I analyzed simply do not support the underlying functionality—and not because they are using different commands for the same functionality. Whether this is the case for a third-party vendor can be ascertained from the third-party vendor user manuals.

197. Based on the analysis below, and also based on my analysis of the common CLI features (*e.g.*, privileged and non-privileged modes, command completion, command abbreviations, context-sensitive help using the "?" key) that were supported and already present in legacy pre-Cisco systems like TOPS-20, I do not agree with Mr. Lougheed's deposition testimony that the accused CLI features in this litigation represent a "look and feel that … represents that this [the CLI] is a Cisco product, not necessarily someone else's product." *See* Lougheed Dep. Tr. at 120. Instead, the accused CLI features in this lawsuit are common across the vast majority of CLIs used by networking vendors, and were also used in CLIs before Cisco existed. I do, however, agree that the accused CLI features constitute a CLI "look and feel that … customers are familiar with" and "are comfortable with" (*id.* at 120), but in my opinion, based on the analysis in this

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Report, the reason for that familiarity and comfort stems from the fact that these features are part of and commonplace in the *de facto* industry-standard CLI that the networking industry has long supported.

198. I also note that among Brocade (which now owns Foundry), Juniper, Alcatel Lucent, and Extreme Networks (which now owns Enterasys Networks), these vendors collectively use approximately 360 of the disputed CLI commands in this litigation. *See* **Appendix G**. An exact count can be gleaned from reviewing and counting the commands for those vendors, which are listed in Appendices H.BR, H.F, H.JE, H.ALU, and H.EX.

1. ADTRAN CLI

199. ADTRAN, Inc. is a global provider of networking and communications equipment headquartered in Huntsville, Alabama. Incorporated in 1985, ADTRAN began operations in 1986 following AT&T's divestiture of the Regional Bell Operating Companies (RBOCs). Among its products and services, ADTRAN sells Fast, Gigabit, Stacking and ActivReach Ethernet switches for small- and medium-sized businesses as well as multi-site enterprise networks. *See* http://portal.adtran.com/web/page/portal/Adtran/wp_corporateoverview_landing; http://portal.adtran.com/web/page/portal/Adtran/group/4486. ADTRAN identifies Cisco, Alcatel Lucent, Avaya, Extreme Networks, HP, Juniper, and others in the Ethernet market as its top competitors. http://portal.adtran.com/web/page/portal/Adtran/wp_investorservices_investorfaqs.

200. As stated on ADTRAN's corporate website, "The NetVanta line of business-class Ethernet switches are ideal for Small- and Medium-sized Businesses

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(SMBs) or multi-site enterprise networks, and include Fast Ethernet, Gigabit, Stacking and ActivReach switches. The NetVanta switches offer the best value in the industry with business-class features, cloud-management, industry leading warranties and world-class ProServices, for full life-cycle support." *See* http://portal.adtran.com/web/page/portal/Adtran/group/4495.

201. I have analyzed ADTRAN product manuals for several of its networking products for purposes of this Report. Those product manuals include:

i) "ADTRAN OPERATING SYSTEM (AOS) Command Reference Guide" (Apr. 2003) [ARISTANDCA13172865]

ii) "ADTRAN OPERATING SYSTEM (AOS) Command Reference Guide AOS Version 11.1 NetVanta 5000 Series Products" (Nov. 2005) [ARISTANDCA13173433]

iii) "ADTRAN OPERATING SYSTEM (AOS) Command Reference Guide AOS Version R11.8.0" (Aug. 2015) [ARISTANDCA13178601]

202. It is my opinion that the ADTRAN networking products I analyzed for this Report support or supported an industry standard CLI, and have or had substantial similarities in functionality, including CLI commands, command hierarchies, command modes, and command prompts, to both Cisco CLIs and the Arista EOS CLI.

203. Based on my review of ADTRAN materials, it is my opinion that ADTRAN networking products, including the NetVanta line of Ethernet switches and other products that use the ADTRAN OPERATING SYSTEM (or AOS), support an industry standard CLI and have substantial similarities in features and functionality to

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Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

204. For example, the AOS CLI as early as 2003 supported command modes and prompts that were substantially similar to the disputed command modes and prompts in this litigation. A comparison of disputed Cisco command modes and prompts, and the AOS CLI command modes and prompts as of April 2003 is shown below:

Cisco Command Mode	Cisco Command Prompt[57]	AOS Command Mode	AOS Command Prompt
User EXEC	router> switch>	Basic (command security level)	Router>
Privileged EXEC	router# switch#	Enable (command security level)	Router#
Global Configuration	router(config)# switch(config)#	Global (configuration mode)	Router(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface (configuration mode)	Router(config-*interface*)#[58]

[ARISTANDCA13172865 at Pages 8-9] (April 2003 AOS CLI manual); *see also* [ARISTANDCA13173433 at Pages 9-10] (Nov. 2005 AOS CLI manual); [ARISTANDCA13178601 at Pages 42-44, 92, 1081, 2038] (Aug. 2015 AOS CLI manual).

205. As explained in the April 2003 AOS Command Reference manual, "The

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[57] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

[58] The *interface* will depend on the specific interface being configured. For example, the interface configuration prompt may be "Router(config-eth 0/1)#" for a particular interface. *See, e.g.*, [ARISTANDCA13172865 at Pages 8-9] (April 2003 AOS CLI manual).

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ADTRAN CLI has two command security levels —Basic and Enable. Both levels support a specific set of commands. For example, all interface configuration commands are accessible only through the Enable security level." [ARISTANDCA13172865 at Page 8] (April 2003 AOS CLI manual). The "Basic" command security level operates in substantially the same way as the "EXEC" and "User EXEC" command modes supported many other vendors, including the disputed Cisco CLIs and Arista EOS CLI, and shares the same command prompt. The "Enable" command security level operates in substantially the same way as the "Privileged EXEC" command modes supported many other vendors, including the disputed Cisco CLIs and Arista EOS CLI, and shares the same command prompt. This functionality remains present in the ADTRAN AOS CLI as of 2015. *See* [ARISTANDCA13178601 at Pages Pages 42-44, 92, 1081, 2038] (Aug. 2015 AOS CLI manual).

206. The April 2003 AOS Command Reference manual also explains: "The ADTRAN CLI has four configuration modes to organize the configuration commands – Global, Line, Router, and Interface. Each configuration mode supports a set of commands specific to the configurable parameters for the mode. For example, all frame relay configuration commands are accessible only through the Interface Configuration Mode (for the virtual frame relay interface)." [ARISTANDCA13172865 at Page 9] (April 2003 AOS CLI manual). The Global configuration mode and Interface configuration mode supported by the AOS CLI operate in substantially the same way as the Global configuration and Interface configuration modes at issue in this lawsuit, including such modes supported by the disputed Cisco CLIs and Arista EOS CLI. The command prompt for the Global configuration mode in the AOS CLI is the same, and the command prompt

for the Interface configuration mode is similar to the disputed Cisco CLIs and Arista EOS CLI. This configuration mode functionality remains present in the ADTRAN AOS CLI as of 2015. *See, e.g.* [ARISTANDCA13178601 at Pages 1081, 2038] (Aug. 2015 AOS CLI manual).

207. The ADTRAN AOS CLI as early as 2003 also supported several other common CLI features that are present in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality: "Pressing the <Tab> key after entering a partial (but unique) command will complete the command, display it on the command prompt line, and wait for further input." *See* [ARISTANDCA13172865 at Page 10] (Apr. 2003 AOS CLI manual).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI, as explained below:

The ADTRAN CLI contains help to guide you through the configuration process. Using the question mark, do any of the following:

- Display a list of all subcommands in the current mode. For example:
```
Router(config-t1 1/1)#coding ?
ami - Alternate Mark Inversion
b8zs - Bipolar Eight Zero Substitution
```
- Display a list of available commands beginning with certain letter(s). For example:
```
Router(config)#ip d?
default-gateway  dhcp-server  domain-lookup  domain-name
domain-proxy
```
- Obtain syntax help for a specific command by entering the command, a space, and then a question mark (?). The ADTRAN CLI displays the range of values and a brief description of the next parameter expected for that particular command. For example:
```
Router(config-eth 0/1)#mtu ?
<64-1500> - MTU (bytes)
```

See [ARISTANDCA13172865 at Page 10] (Apr. 2003 AOS CLI manual).

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iii) Entering partial commands (called "auto finish" by ADTRAN) into the CLI, such as "int" for "interface," so long as you "enter enough letters to identify a command as unique." *See* [ARISTANDCA13172865 at Page 10] (Apr. 2003 AOS CLI manual).

iv) Use of a "no" keyword before a CLI command "[t]o undo an issued command or to disable a feature[.]" *See* [ARISTANDCA13172865 at Page 11] (Apr. 2003 AOS CLI manual).

208. The ADTRAN networking products I analyzed for this Report also support well over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the ADTRAN networking equipment CLIs and Cisco CLIs is provided in **Appendix H.AD**. As shown in that detailed analysis, ADTRAN has supported at least 178 of the same Cisco CLI commands that are disputed in this lawsuit.

209. My opinion that Adtran networking products support an industry-standard CLI is further supported by Adtran's own product documentation. For example, the datasheet for the Adtran NetVanta 3305 series of access routers, which bears a date of November 2004, states: "The ADTRAN OS offers a standard Command Line Interface (CLI) that mimics the widely adopted, industry *de facto* standard. Using an already familiar CLI virtually eliminates training costs associated with learning a new operating system or costly industry certifications." *See* ARISTANDCA00264627. A January 2005 AdTran product document for its NetVanta 3000 Series similarly states: "Command Line

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Interface (CLI) that mimics *de facto* industry-standard." *See* ARISTANDCA00264633.

2. Alcatel and Alcatel-Lucent (ALU) CLIs

210. Alcatel-Lucent S.A. ("ALU") was acquired by Nokia in January 2016, and the ALU networking product portfolio is now being offered under the Nokia brand. *See, e.g.*, http://company.nokia.com/en/news/press-releases/2016/01/14/nokia-celebrates-first-day-of-combined-operations-with-alcatel-lucent; http://company.nokia.com/en/news/press-releases/2016/01/04/nokia-gains-control-of-alcatel-lucent-through-successful-public-exchange-offer-nokia-to-hold-nearly-80-of-outstanding-alcatel-lucent-shares. In this Report, for simplicity and to avoid confusion, I will nevertheless refer to ALU and its networking products without reference to Nokia's recent acquisition of ALU.

211. ALU (now part of Nokia) sells communications and networking products and services, including routers and switches, and was created in 2006 from the combination of Alcatel and Lucent Technologies. *See, e.g.*, https://www.alcatel-lucent.com/about/history; http://networks.nokia.com/portfolio/products/ip-routing. Per ALU's 2015 Annual Report on Form 20-F, Adtran, Cisco, and Juniper are among ALU's competitors in the marketplace. http://www3.alcatel-lucent.com/wps/DocumentStreamerServlet?LMSG_CABINET=Docs_and_Resource_Ctr&LMSG_CONTENT_FILE=Financial_Info/Income_Statements/ALU-20-F-28042016-FINAL.pdf&lu_lang_code=en_WW.

212. I have analyzed ALU and Alcatel product manuals for several of their networking products for purposes of this Report.[59] Those product manuals include:

[59] As discussed in the Avaya portion of this Report, both Avaya and ALU have historical ties to Lucent

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i) "Alcatel OS-6200 User Guide" (Aug. 2006) [ARISTANDCA00281693]

ii) "Alcatel OS-LS-6200 User Guide" (Aug. 2009) [ARISTANDCA13187525]

iii) "Alcatel-Lucent OmniSwitch CLI Reference Guide" (June 2012) [ARISTANDCA13189829]

iv) "Alcatel-Lucent OmniSwitch AOS Release 6250/6350/6450 CLI Reference Guide" (Sept. 2015) [ARISTANDCA13206391]

213. It is my opinion that the ALU and Alcatel networking products I analyzed for this Report support or supported an industry standard CLI, and have or had substantial similarities in functionality, including CLI commands, command hierarchies, command modes, and command prompts, to both Cisco CLIs and the Arista EOS CLI.

214. Based on my review of ALU and Alcatel materials, it is my opinion that ALU and Alcatel networking products, including the OmniSwitch line of Ethernet switches, support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

215. For example, the Alcatel CLI at least as of 2006 supported command modes and prompts that were substantially similar, if not identical, to the disputed command modes and prompts in this litigation. A comparison of disputed Cisco

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Technologies. I have included an analysis of at least one Lucent Technologies networking device in the Avaya portion of this Report.

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command modes and prompts, and the Alcatel CLI command modes and prompts, is shown below:

Cisco Command Mode	Cisco Command Prompt[60]	Alcatel Command Mode	Alcatel Command Prompt
User EXEC	router> switch>	Normal Exec	Console>
Privileged EXEC	router# switch#	Privileged Exec	Console#
Global Configuration	router(config)# switch(config)#	Global Configuration	Console(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	Console(config-if)#

[ARISTANDCA00281693] at Pages 251-253 (Aug. 2006 Alcatel User Guide); [ARISTANDCA13187525] at Pages 262-265 (Aug. 2009 Alcatel User Guide).

216. The Alcatel CLI at least as of 2006 also supported several other common CLI features that are present in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality: "If you terminate input with a Tab key, the CLI will print the remaining characters of a partial keyword up to the point of ambiguity. In the "logging history" example, typing log followed by a tab will result in printing the command up to "logging." *See* [ARISTANDCA00281693 at Page 249] (Aug. 2006 Alcatel User Guide); [ARISTANDCA13187525 at Page 260] (Aug. 2009 Alcatel User Guide).

[60] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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ii) A context-sensitive help system triggered by entering the "?" character into the CLI: "You can display a brief description of the help system by entering the help command. You can also display command syntax by using the '?' character to list keywords or parameters. … If you enter a '?' at the command prompt, the system will display the first level of keywords for the current command class (Normal Exec or Privileged Exec) or configuration class (Global, ACL, DHCP, Interface, Line, VLAN Database, or MSTP). You can also display a list of valid keywords for a specific command. For example, the command 'show ?' displays a list of possible show commands[.] … If you terminate a partial keyword with a question mark, alternatives that match the initial letters are provided. (Remember not to leave a space between the command and question mark.) For example 's?' shows all the keywords starting with 's.'" [ARISTANDCA00281693 at Pages 249-251] (Aug. 2006 Alcatel User Guide); [ARISTANDCA13187525] at Pages 260-262 (Aug. 2009 Alcatel User Guide).

iii) Entering partial commands (called "minimum abbreviation" by Alcatel) into the CLI: "The CLI will accept a minimum number of characters that uniquely identify a command. For example, the command "configure" can be entered as con. If an entry is ambiguous, the system will prompt for further input." *See* [ARISTANDCA00281693] at Page 249 (Aug. 2006 Alcatel User

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Guide); [ARISTANDCA13187525] at Page 260 (Aug. 2009 Alcatel User Guide).

iv) Use of a "no" keyword before a CLI command to "negat[e] the effect of commands": "For many configuration commands you can enter the prefix keyword 'no' to cancel the effect of a command or reset the configuration to the default value. For example, the logging command will log system messages to a host server. To disable logging, specify the no logging command. This guide describes the negation effect for all applicable commands." *See* [ARISTANDCA00281693] at Page 251 (Aug. 2006 Alcatel User Guide); [ARISTANDCA13187525] at Page 262 (Aug. 2009 Alcatel User Guide).

217. The Alcatel and ALU networking products I analyzed for this Report also support well over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Alcatel and ALU networking equipment CLIs and Cisco CLIs is provided in **Appendix H.ALU**. As shown in that detailed analysis, Alcatel and Alcatel-Lucent have supported at least 138 of the same Cisco CLI commands that are disputed in this lawsuit.

3. Allied Telesis CLI

218. Allied Telesis, Inc. sells IP/Ethernet network solutions to the global marketplace, including core-to-edge networking technologies such as Fast Ethernet Switches, Managed Gigabit Switches, Industrial Ethernet Layer 2 and 3 Switches, and other products for Enterprise, Campus, Branch and Data Center networks. *See, e.g.,*

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http://www.alliedtelesis.com/about; http://www.alliedtelesis.com/products; http://www.alliedtelesis.com/products/switches. The company was founded in 1987. *See* http://www.alliedtelesis.com/allied-telesis-leadership.

219. I have analyzed Allied Telesis product manuals for several of its networking products for purposes of this Report. Those product manuals include:

i) "High-Density Layer 3 Stackable Gigabit Ethernet Switch AT-9724TS Command Line Interface Reference Manual" (Apr. 2005) [ARISTANDCA13183735]

ii) "CLI User's Guide AT-8000GS Series Stackable Gigabit Ethernet Switches Version 1.0.1" (July 2008) [ARISTANDCA00278182]

iii) "CLI User's Guide AT-8000GS Series Stackable Gigabit Ethernet Switches Version 2.0.0.19" (June 2009) [ARISTANDCA13184679]

iv) "Command Line Interface User's Guide AT-8000GS Series Stackable Gigabit Ethernet Switches Version 2.0.0.22" (Sept. 2011) [ARISTANDCA13185473]

v) "AT-8100 Series Fast Ethernet Switches Management Software Command Line Interface User's Guide AlliedWare Plus Version 2.4.1.0" (2015) [ARISTANDCA00275385]

220. It is my opinion that the Allied Telesis networking products I analyzed for this Report support or supported an industry standard CLI, and have or had substantial similarities in functionality, including CLI commands, command hierarchies, command modes, and command prompts, to both Cisco CLIs and the Arista EOS CLI.

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221. Based on my review of Allied Telesis materials, it is my opinion that Allied Telesis networking products, including their Ethernet switches, support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

222. For example, the Allied Telesis CLI at least as of 2008 supported command modes and prompts that were substantially similar, if not identical, to the disputed command modes and prompts in this litigation. A comparison of disputed Cisco command modes and prompts, and the Allied Telesis CLI command modes and prompts, is shown below:

Cisco Command Mode	Cisco Command Prompt[61]	Allied Telesis Command Mode	Allied Telesis Command Prompt
User EXEC	router> switch>	User Exec	Console>
Privileged EXEC	router# switch#	Privileged Exec	Console#
Global Configuration	router(config)# switch(config)#	Global Configuration	Console(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	Console(config-if)#

[ARISTANDCA00278182] at Pages 5-6, 21 (July 2008 Allied Telesis CLI User's Guide).

223. The Allied Telesis CLI at least as of 2008 also supported several other

[61] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

common CLI features that are present in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality. *See* [ARISTANDCA00278182 at Page 10] (July 2008 Allied Telesis CLI User's Guide).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI: "The standard command to request help is ?. … There are two instances where help information can be displayed: ... Keyword lookup — The character ? is entered in place of a command. A list of all valid commands and corresponding help messages are is displayed. … Partial keyword lookup — If a command is incomplete and or the character ? is entered in place of a parameter. The matched keyword or parameters for this command are displayed." [ARISTANDCA00278182 at Page 9] (July 2008 Allied Telesis CLI User's Guide).

iii) Use of a "no" keyword before a CLI command for negating the effect of CLI commands. *See* [ARISTANDCA00278182 at Page 10] (July 2008 Allied Telesis CLI User's Guide).

224. The Allied Telesis networking products I analyzed for this Report also support at least a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Allied Telesis networking equipment CLIs and Cisco CLIs is provided in **Appendix**

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H.AT. As shown in that detailed analysis, Allied Telesis products supported at least 100 of the same Cisco CLI commands that are disputed in this lawsuit.

4. Avaya, Nortel Networks, and Lucent CLIs

225. Avaya, Inc. sells communications and networking products and services, including enterprise Ethernet switches and software defined networking products. *See*, *e.g.*, http://www.avaya.com/usa/products/; http://www.avaya.com/usa/products/ethernet-switches/. Its Layer 2 and 3 Ethernet switching networking products and services compete with companies including Cisco, HP Enterprise, Dell, and Juniper, among others. *See* Avaya 2015 Form 10-K Annual Report at http://www.avaya.com/investors/usa/document/avaya-2015--10-k_final.pdf. (Page 19).

226. Avaya became an independent company in October 2002. Prior to that date, Avaya operated as part of Lucent Technologies' enterprise communications group, and before that, it operated as part of AT&T. *See, e.g.*, http://www.avaya.com/usa/about-avaya/our-company/history/history/.

227. Avaya acquired Nortel Enterprise Solutions in 2009, which broadened Avaya's networking products. *See, e.g.*, http://www.avaya.com/usa/about-avaya/our-company/history/avaya-acquisitions/; http://www.avaya.com/usa/about-avaya/newsroom/news-releases/2009/pr-091218/.

228. Avaya's current portfolio of networking products includes Ethernet switches. Current models of Avaya Ethernet switches include the Ethernet Routing Switch (ERS) 3500 Series, the ERS 4000 Series, and other "series" of ERS products. Avaya also sells a Virtual Services Platform (VSP) line of Ethernet switches, including the VSP 4000 Series, 7000 Series, and other "series" of VSP products. *See*, *e.g.*,

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http://www.avaya.com/usa/products/ethernet-switches/.

229. Many of the Avaya ERS products are rebranded Nortel switches per the Avaya website. *See, e.g.*, http://downloads.avaya.com/css/P8/documents/100125417. Indeed, the Nortel manuals I reviewed for this Report also follow the "Ethernet Routing Switch" naming convention for Nortel switches.

230. I understand that Avaya produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to Avaya, Nortel, and Lucent networking products. I also understand that a Dell representative executed a sworn declaration attesting that the documents produced by Dell under the subpoena are authentic copies of documents created in the ordinary course of business.

231. I have analyzed Avaya, Nortel, and Lucent product manuals for several of their networking products for purposes of this Report. Those product manuals include:

i) "Lucent Technologies Cajun P550/P220 Command Line Interface Reference Guide Version 4.0 November 2, 1999" (Nov. 1999) [ARISTANDCA_AVAYA00019023]

ii) "Nortel Ethernet Routing Switch 8600 Commands Reference — NNCLI Release: 5.1 Document Revision: 01.01" (Mar. 2009) [ARISTANDCA00273853]

iii) "Nortel Ethernet Routing Switch 8300 Command Reference — CLI" (Aug. 2007) [ARISTANDCA_AVAYA00019736]

iv) "Nortel Ethernet Routing Switch 8300 Command Reference — NNCLI" (Aug. 2007)

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[https://downloads.avaya.com/css/P8/documents/100100636]

[ARISTANDCA00273406]

v) "NNCLI Command Line Reference for the Ethernet Routing Switch 8300 Ethernet Routing Switch 8300 Software Release 2.3" (Dec. 2005) [ARISTANDCA00274864]

vi) "Commands Reference — ACLI Avaya Ethernet Routing Switch 8300 4.2 NN46200-104, 02.05 November 2011 (Nov. 2011) [ARISTANDCA_AVAYA00021508]

vii) "User Interface Fundamentals Avaya Ethernet Routing Switch 8800/8600 7.1.3 NN46205-308, 05.01 January 2012" (Jan. 2012) [https://downloads.avaya.com/css/P8/documents/100128482] [ARISTANDCA00274794]

viii) "NN46205-106 Avaya Command Line Interface Commands Reference ERS 8600/8800 Release 7.2 Version 01.02 October 11 2012" (Oct. 2012) [ARISTANDCA_AVAYA00022577]

ix) "NN47203-103 Avaya Command Line Interface Commands Reference

Version 01.01 February 2013" (Feb. 2013) [ARISTANDCA_AVAYA00026225]

x) "NN47227-104 VSP 8000 Series Avaya Command Line Reference Manual VSP 8000 Series Release 4.2.1 Version 05.01 June 2015" (June 2015) [ARISTANDCA_AVAYA00031076]

xi) "NN47211-105 ACLI Command Reference Guide for Avaya

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Ethernet Routing Switch 5900 series ERS 5900 series Release 7.1 Version 03.AB January 2016" (Jan. 2016) [ARISTANDCA_AVAYA00084952]

232. It is my opinion that the Avaya, Nortel, and Lucent networking products I analyzed for this Report support or supported an industry standard CLI, and have or had substantial similarities in functionality, including CLI commands, command hierarchies, command modes, and command prompts, to both Cisco CLIs and the Arista EOS CLI.

233. Based on my review of Avaya, Nortel, and Lucent materials, it is my opinion that Avaya, Nortel, and Lucent networking products, specifically Ethernet switches, support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

234. For example, the Lucent Technologies Cajun P550/P220 switches supported a CLI that operating via command modes and prompts that were substantially similar to the disputed command modes and prompts in this litigation. As explained in a November 1999 Lucent Cajun P550/P220 CLI manual, "The Cajun P550/P220 CLI consists of various command modes. The commands you can enter depend on the mode you are in. Each command mode has a distinct prompt." [ARISTANDCA_AVAYA00019023 at Page 1-2] (Nov. 1999 Lucent Cajun P550/P220 CLI Reference Guide). A comparison of the disputed Cisco command modes and prompts, and the Lucent Cajun P550/P220 command modes and prompts from November

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1999 is shown below:

Cisco Command Mode	Cisco Command Prompt[62]	Lucent Command Mode	Lucent Command Prompt
User EXEC	router> switch>	User	Cajun>
Privileged EXEC	router# switch#	Privileged	Cajun#
Global Configuration	router(config)# switch(config)#	Global	Cajun (configure)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface	Cajun (config-if:interface)#

[ARISTANDCA_AVAYA00019023 at Page 1-2, Table 1-1] (Nov. 1999 Lucent Cajun P550/P220 CLI Reference Guide).

235. The "User," "Privileged," "Global," and "Interface" command modes supported by the Lucent Cajun P550/P220 switch CLI functioned in substantially the same manner in November 1999 as the disputed "User EXEC," "Privileged EXEC," "Global Configuration," and "Interface Configuration" command modes in the Cisco CLIs and accused Arista EOS CLI. As described in the Lucent Cajun P550/P220 CLI manual:

i) The "User" command mode: "The mode you are in after login. It includes a limited number of commands to display status and statistic information."

ii) The "Privileged" command mode: "Contains the commands from the User mode and the commands to set operating parameters."

[62] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

iii) The "Global" command mode: "Commands to configure the system as a whole."

iv) The "Interface" command mode: "Commands to configure the interfaces."

[ARISTANDCA_AVAYA00019023 at Page 1-2, Table 1-1] (Nov. 1999 Lucent Cajun P550/P220 CLI Reference Guide).

236. The Lucent Cajun P550/P220 CLI, as early as November 1999, also shared several other common CLI functionality that are found in the disputed Cisco CLIs and the Arista EOS CLI, including:

i) The Lucent Cajun P550/P220CLI supported a context specific "help" system where the user types in a "?" to trigger the CLI's help system, just like the disputed Cisco CLIs and the Arista EOS CLI. [ARISTANDCA_AVAYA00019023 at Page 1-4, Table 1-3] (Nov. 1999 Lucent Cajun P550/P220 CLI Reference Guide).

ii) The Lucent Cajun P550/P220 CLI, as early as November 1999, supported command completion functionality, just like the disputed Cisco CLIs and the Arista EOS CLI. [ARISTANDCA_AVAYA00019023 at Page 1-4, Table 1-3] (Nov. 1999 Lucent Cajun P550/P220 CLI Reference Guide).

iii) The Lucent Cajun P550/P220 CLI, as early as November 1999, also supported the "no" form of configuration commands, which the manual describes: "Most CLI commands have a no form. In general, the no form disables a feature/function or restores a

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default for Layer 3 commands. Clear disables the Layer 2 set commands. The Description section of each command describes the no or clear form (if applicable to the command).” [ARISTANDCA_AVAYA00019023 at Page 1-5] (Nov. 1999 Lucent Cajun P550/P220 CLI Reference Guide).

237. Similarly, the Nortel Ethernet Routing Switch product line supported the same four command modes that are disputed in this litigation as early as Aug. 2007, with substantially the same—if not identical—prompts for each command mode: (1) User EXEC, (2) Privileged EXEC, (3) Global Configuration, and (4) Interface Configuration. [ARISTANDCA00273406 at Pages 42-43] (Aug. 2007 Nortel Ethernet Routing Switch 8300 Command Reference — NNCLI). A comparison of disputed Cisco command modes and prompts and the command modes and prompts supported by the Nortel Ethernet Routing Switch product line’s NNCLI is summarized below:

Cisco Command Mode	Cisco Command Prompt[63]	Nortel NNCLI Command Mode	Nortel NNCLI Command Prompt
User EXEC	router> switch>	User EXEC	Passport-8300:5>
Privileged EXEC	router# switch#	Privileged EXEC	Passport-8300:5#
Global Configuration	router(config)# switch(config)#	Global Configuration	Passport-8300:5(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	Passport-8300:5(config-if)#

[ARISTANDCA00273406 at Pages 42-43] (Aug. 2007 Nortel Ethernet Routing Switch

[63] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco’s Response to Arista Interrogatory No. 2, Exh. C.

8300 Command Reference — NNCLI); [ARISTANDCA00274864 at Pages 26-28] (Dec. 2005 NNCLI Command Line Reference for the Ethernet Routing Switch 8300).

238. Avaya-branded Ethernet Routing Switch products also supported the same four common command modes in dispute in this litigation: (1) User EXEC; (2) Privileged EXEC; (3) Global Configuration; and (4) Interface configuration. *See, e.g.*, [ARISTANDCA_AVAYA00021508 at Page 45] (Nov. 2011 Commands Reference — ACLI Avaya Ethernet Routing Switch 8300 (listing all four command modes for the "logout" command); [ARISTANDCA_AVAYA00022577 at Page 24] (Oct. 2012 Avaya Command Line Interface Commands Reference for ERS 8600/8800 (listing out these four command modes, and other supported command modes).

239. The Avaya command prompts associated with these four command modes are also substantially similar to the command prompts in dispute in this litigation.

Cisco Command Mode	**Cisco Command Prompt**[64]	**Avaya ERS 8600 Command Mode**	**Avaya ERS 8600 Command Prompt**
User EXEC	router> switch>	User EXEC	ERS-8600:5>
Privileged EXEC	router# switch#	Privileged EXEC	ERS-8600:5#
Global Configuration	router(config)# switch(config)#	Global Configuration	ERS-8600:5<config>#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	ERS-8600<config-if>#

[ARISTANDCA00274794 at Pages 11-12] (Jan. 2012 User Interface Fundamentals Avaya Ethernet Routing Switch 8800/8600).

[64] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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240. These Avaya-supported command modes and prompts serve substantially the same functional purpose as the four disputed command modes and prompts disputed in this lawsuit. As the Avaya product documentation explains, these command modes are supported by Avaya as part of its "industry standard CLI."

> ACLI is an industry standard CLI that you can use for device management across Avaya products.
>
> The ACLI has five major command modes, listed in order of increasing privileges. After you start a session on the switch, you begin in user EXEC mode. entering `enable` followed by a login name and password enters you into the privileged Exec mode. From privileged Exec mode, you can type any EXEC command or go to global configuration mode. From global configuration mode, you can enter either the interface configuration mode or the router configuration mode, depending on whether you want to configure an interface or a protocol.
>
> Each mode provides a specific set of commands. The command set of a privilege mode at a higher level is a superset of a privilege mode at a lower level. You can access all privilege mode commands below a privilege mode at a higher level.

[ARISTANDCA00274794 at Page 10] (Jan. 2012 User Interface Fundamentals Avaya Ethernet Routing Switch 8800/8600).

241. The functionality associated with each Avaya command mode is also substantially the same—if not identical to—the operation of the command modes at issue in this lawsuit. The Avaya product documentation explains the different command modes as follows:[65]

> • user EXEC—the initial mode of access. Only a limited number of commands are available in EXEC mode.

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[65] The Arista EOS CLI and other vendors' CLIs also support several other common command modes and prompts that are not specifically addressed in this Report. I have focused the discussion in this Report on the particular command modes and prompts identified by Cisco in its discovery responses as in dispute in this litigation. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C. I reserve all rights to respond to any other allegations that Cisco may raise beyond what it identified in its discovery responses, to the extent the Court permits it to do so.

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- privilege EXEC—accessed from the user EXEC mode. After you access this mode, you are prompted to provide a login name and password. The login name and password combination determines your access level in the privileged Exec mode and higher modes. Type `enable` to enter this mode from user EXEC mode. At the password prompt, type `avaya`. Most EXEC commands are one-time commands, such as show commands, which show the current configuration status. The EXEC commands are not saved across reboots.

- global configuration—use this mode to make changes to the running configuration. If you save the configuration, these settings survive a reboot of the switch.

- interface configuration—use this mode to modify either a logical interface, such as a virtual local area network (VLAN), or a physical interface, such as a port/slot. You can configure the following interfaces:
  - FastEthernet
  - GigabitEthernet
  - Loopback
  - MLT
  - VLAN

[ARISTANDCA00274794 at Page 10] (Jan. 2012 User Interface Fundamentals Avaya Ethernet Routing Switch 8800/8600).

242. The Avaya networking products I analyzed for this Report also over a hundred of industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Avaya networking equipment CLIs and Cisco CLIs is provided in **Appendix H.AV**. As shown in that detailed analysis, Avaya networking equipment has supported at least 117 of the same Cisco CLI commands that are disputed in this lawsuit.

5. Brocade and Foundry CLIs

243. Brocade Communications sells switches, storage networking, and routing products, including data center switches, campus network switches, carrier Ethernet switches, and Ethernet routers. *See, e.g.*,. http://www.brocade.com/en/products-

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services.html. Brocade was founded in 1999 in Delaware and competes with both Arista and Cisco in the Ethernet market, per Brocade's own investor "FAQ." http://www.brcd.com/faq.cfm.

244. In December 2008, Brocade announced its acquisition of Foundry Networks, a vendor of enterprise network switching and routing products, including Layer 2/3 LAN switches, Layer 3 Backbone switches, Layer 4-7 application switches, wireless LAN and access points, metro routers and core routers. Foundry was founded in 1996, and Brocade's acquisition of Foundry expanded Brocade's networking portfolio into the Ethernet switch market. *See, e.g.*, http://newsroom.brocade.com/manual-releases/2008/Brocade-Completes-Acquisition-of-Foundry-Networks; http://newsroom.brocade.com/manual-releases/2008/Brocade-Announces-Definitive-Agreement-to-Acquire-; http://www.brcd.com/faq.cfm.

245. I understand that Brocade produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to Brocade and Foundry networking products. I also understand that a Brocade representative executed a sworn declaration attesting that the documents produced by Brocade under the subpoena are authentic copies of documents created in the ordinary course of business.

246. I have analyzed Brocade and Foundry product manuals for several of their networking products for purposes of this Report. Those product manuals include:

i) "Brocade Network OS Command Reference Supporting Network OS v5.0.1" (Sept. 2014) [ARISTANDCA_BROCADE01742302]

ii) "Brocade Network OS Command Reference Supporting Network

OS v6.0.2" (Dec. 2015) [ARISTANDCA_BROCADE01785618]

iii) "Foundry Switch and Router Command Line Interface Reference" (June 2001) [ARISTANDCA_BROCADE00000261]

iv) "Foundry Switch and Router Command Line Interface Reference" (Nov. 2002) [ARISTANDCA_BROCADE00001802]

v) "Foundry ServerIron® Switch Command Line Interface Reference" (June 2003) [ARISTANDCA_BROCADE00313978]

vi) "Foundry Switch and Router Command Line Interface Reference" (Jan. 2006) [ARISTANDCA_BROCADE00215581]

vii) "Foundry Switch and Router Command Line Interface Reference IronCore JetCore BigIron MG8 NetIron 40G NetIron IMR 640 FastIron Edge Switch" (Apr. 2007) [ARISTANDCA_BROCADE00012094]

I also considered for purposes of this Report: ARISTANDCA_BROCADE00062898, ARISTANDCA_BROCADE01689556, ARISTANDCA_BROCADE01363517, ARISTANDCA_BROCADE00055686.

247. Based on my review of Brocade and Foundry materials, it is my opinion that Brocade and Foundry networking products, including their Ethernet switches, support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

248. For example, the Foundry CLI at least as of 2001 supported command modes and prompts that were substantially similar, if not identical, to the disputed command modes and prompts in this litigation. A comparison of disputed Cisco command modes and prompts, and the Foundry CLI command modes and prompts from 2001, is shown below:

Cisco Command Mode	Cisco Command Prompt[66]	Foundry Command Mode	Foundry Command Prompt
User EXEC	router> switch>	User EXEC	BigIron>
Privileged EXEC	router# switch#	Privileged EXEC	BigIron#
Global Configuration	router(config)# switch(config)#	Global CONFIG	BigIron(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface CONFIG	BigIron(config-if-5/1)#[67]

[ARISTANDCA_BROCADE00000261 at Pages 2-1 to 2-6] (June 2001 Foundry CLI Manual).

249. The Foundry command modes and prompts persist in Brocade's networking products as of December 2015:

Cisco Command Mode	Cisco Command Prompt[68]	Brocade Command Mode	Brocade Command Prompt

[66] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.
[67] The "5/1" in the exemplary Interface CONFIG command prompt reflects the particular interface being configured, which is substantially similar to the Arista EOS CLI command prompt for Interface Configuration mode. [ARISTANDCA_BROCADE00000261 at Pages 2-1 to 2-6] (June 2001 Foundry CLI Manual).
[68] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

User EXEC	router> switch>	User EXEC	device>
Privileged EXEC	router# switch#	Privileged EXEC	device#
Global Configuration	router(config)# switch(config)#	Global configuration	device(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface subtype configuration	device(config-if-e1000-1/1/1)#[69]

[ARISTANDCA_BROCADE01785618 at Pages 38-45, 385] (Dec. 2015 Brocade Network OS Command Reference); [ARISTANDCA_BROCADE01363517 at Pages 37-38] (Dec. 2015 Brocade FastIron Command Reference); [ARISTANDCA_BROCADE01530651 at Pages 25-27] (Aug. 2015 Brocade NetIron Command Reference).

250. These command modes and prompts operated in substantially the same way as the disputed command modes and prompts in this litigation. As the June 2001 Foundry CLI Manual describes:

i) "User EXEC – Lets you display information and perform basic tasks such as pings and trace routes."

ii) "Privileged EXEC – Lets you use the same commands as those at the User EXEC level plus configuration commands that do not require saving the changes to the system-config file."

iii) "The global CONFIG level allows you to globally apply or modify

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[69] The "e1000-1/1/1" in the exemplary Interface subtype configuration command prompt reflects the particular interface being configured, which is substantially similar to the Arista EOS CLI command prompt for Interface Configuration mode. [ARISTANDCA_BROCADE01363517 at Pages 37-38] (Dec. 2015 Brocade FastIron Command Reference).

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parameters for ports on the switch or router."

iv) "The interface [CONFIG]level allows you to assign or modify specific port parameters on a port-by-port basis."

[ARISTANDCA_BROCADE00000261 at Pages 2-1 to 2-5] (June 2001 Foundry CLI Manual).

251. Recent Brocade CLI command reference manuals from 2015 similarly describe these four command modes, and accurately characterize these features as part of an industry standard CLI familiar to Ethernet/IP networking administrators:

i) "The Brocade [Fastiron] CLI uses an industry-standard hierarchical shell familiar to Ethernet/IP networking administrators. You can use one of three major command modes to enter commands and access sub-configuration modes on the device."

ii) "User EXEC mode is the default mode for the device; it supports the lowest level of user permissions. In this mode, you can execute basic commands such as ping and traceroute, but only a subset of clear, show, and debug commands can be entered in this mode."

iii) "Privileged EXEC mode supports all clear, show, and debug commands. In addition, you can enter some configuration commands that do not make changes to the system configuration. The following example shows the privileged EXEC prompt."

iv) "Global configuration mode supports commands that can change the device configuration. For any changes to be persistent, you

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must save the system configuration before rebooting the device. The global configuration mode provides access to sub-configuration modes for individual interfaces[.]"

v) "The interface [configuration] mode allows you to assign or modify specific port parameters on a specific port."

[ARISTANDCA_BROCADE01363517 at Pages 37-38] (Dec. 2015 Brocade FastIron Command Reference); [ARISTANDCA_BROCADE01530651 at Pages 25-27] (Aug. 2015 Brocade NetIron Command Reference); *see also* [ARISTANDCA_BROCADE01785618 at Pages 38-39] (Dec. 2015 Brocade Network OS Command Reference).

252. The Foundry CLI at least as of 2001 also supported several other common CLI features that are present in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality: "The CLI supports command completion, so you do not need to enter the entire name of a command or option. As long as you enter enough characters of the command or option name to avoid ambiguity with other commands or options, the CLI understands what you are typing." [ARISTANDCA_BROCADE00000261 at Page 2-1] (June 2001 Foundry CLI Manual).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI: "To get a quick display of available options at a CLI level or for the next option in a command string,

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enter a question mark (?) at the prompt or press TAB. … You also can use the question mark (?) with an individual command, to see all available options or to check context." [ARISTANDCA_BROCADE00000261 at Pages 2-1 and 2-7] (June 2001 Foundry CLI Manual).

iii) The use of "syntax shortcuts" to enter partial commands into the CLI: "A command or parameter can be abbreviated as long as enough text is entered to distinguish it from other commands at that level. For example, given the possible commands copy tftp... and config tftp..., possible shortcuts are cop tftp and con tftp respectively. In this case, co does not properly distinguish the two commands." [ARISTANDCA_BROCADE00000261 at Page 2-7] (June 2001 Foundry CLI Manual).

iv) Use of a "no" keyword before a CLI command: "Disables other commands. To disable a command, place the word no before the command." [ARISTANDCA_BROCADE00000261 at Page 6-75] (June 2001 Foundry CLI Manual).

253. Current Brocade networking devices similarly support these standard CLI features that operate in substantially the same way in the disputed Cisco CLIs and Arista EOS CLI:

i) Context-specific "help" system triggered by entering the "?" character in the CLI. *See* [ARISTANDCA_BROCADE0178561 at Pages 46-47] (Dec. 2015 Brocade Network OS Command

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Reference); [ARISTANDCA_BROCADE01530651 at Pages 23, 34] (Aug. 2015 Brocade NetIron Command Reference).

ii) Command completion functionality, which can be triggered by hitting the "Tab" key. *See* [ARISTANDCA_BROCADE0178561 at Page 47] (Dec. 2015 Brocade Network OS Command Reference); [ARISTANDCA_BROCADE01530651 at Pages 24, 30] (Aug. 2015 Brocade NetIron Command Reference).

iii) Syntax shortcuts that allows abbreviated commands to be entered, so long as enough text is entered to distinguish a command from other commands at that level. "For example, given the possible commands copy tftp ... and config tftp ..., possible shortcuts are cop tftp and con tftp respectively." *See* [ARISTANDCA_BROCADE01530651 at Page 36] (Aug. 2015 Brocade NetIron Command Reference).

iv) Use of "no" as a keyword to negate or disable a CLI command. *See, e.g.*, [ARISTANDCA_BROCADE01530651 at Page 41] (Aug. 2015 Brocade NetIron Command Reference).

254. The Foundry and Brocade networking products I analyzed for this Report also support hundreds of industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Foundry and Brocade's networking equipment CLIs and Cisco CLIs is provided in **Appendices H.BR** and **H.F.** As shown in those detailed analyses, Brocade has supported at least 242 of the same Cisco CLI commands that are disputed in this lawsuit. *See*

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Appendix H.BR. And Foundry supported at least 163 of the same Cisco CLI commands that are disputed in this lawsuit. *See* **Appendix H.F**.

255. My opinion that Brocade networking products support an industry-standard CLI is supported by Brocade's own product materials. For example, Brocade's release notes for its IronWare products tout support for "Serial and Telnet Access to industry-standard CLI." *See* [ARISTANDCA_BROCADE02146650 at Page 5]. And its manuals tout that its CLI "uses an industry-standard hierarchical shell familiar to Ethernet/IP networking administrators." *See* [ARISTANDCA_BROCADE01336032 at Page 15].

6. Dell and Force10 Networks CLIs

256. Dell, Inc. is a Texas-based technology company founded by Michael Dell in 1984. Dell sells, in addition to consumer computer and laptop products, high-performance data center networking equipment, including gigabit ethernet switches and chassis switches. *See, e.g.*, http://www.dell.com/learn/us/en/vn/our-history; http://www.dell.com/learn/us/en/uscorp1/corp-comm; http://www.dell.com/us/business/p/enterprise-products; http://www.dell.com/us/business/p/networking-products.aspx.

257. Dell entered the networking and data center switch market in 2001 with its "PowerConnect" line of network switches. http://www.dell.com/learn/us/en/vn/beyond-the-pc. In 2011, Dell acquired Force10 Networks, a high-performance data center networking company founded in 1999, to broaden its product offerings in the computer networking and data center switch market. http://www.dell.com/learn/us/en/uscorp1/corp-comm/acq-force10;

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http://www.dell.com/learn/us/en/uscorp1/secure/2011-07-irfire-pr.

258. After it acquired Force10, Dell continued to sell its PowerConnect and Force10 product lines under those brand names until late 2013, after which it renamed those product lines under the "Dell Networking" brand name. http://partnerdirect.dell.com/sites/channel/Documents/Networking_Rebrand_FAQ.pdf

259. As part of this transition, the operating system that ran on Dell Force10 switches changed from "Dell Force10 Operating System (FTOS)" to "Dell FTOS." http://partnerdirect.dell.com/sites/channel/Documents/Networking_Rebrand_FAQ.pdf

260. Similarly, the operating system that ran on Dell PowerConnect switches changed from "Dell PowerConnect OS" to "Dell PCT OS."

261. I understand that Dell produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to Dell and Force10 networking products. I also understand that a Dell representative executed a sworn declaration attesting that the documents produced by Dell under the subpoena are authentic copies of documents created in the ordinary course of business.

262. I have analyzed the Dell product manuals for several of its networking products for purposes of this report. Those product manuals include:

i) "Dell Networking N-Series N1500, N2000, N3000, and N4000 Switches CLI Reference Guide Version 6.2.5.0 and Later" (May 2015) [ARISTANDCA13242587]

ii) "Dell™ PowerConnect™ 5324 Systems CLI Reference Guide" (Aug. 2006) [DELL-ANETSUB00122372]

iii) "Dell™ PowerConnect™ 3324/3348 Switch CLI Guide" (May

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2003) [DELL-ANETSUB00122116]

iv) "Dell PowerConnect Switch Command Reference" (Mar. 2003) [DELL-ANETSUB00095249]

v) "Dell Force10 SFTOS Command Reference" (Nov. 2011) [DELL-ANETSUB00026077]

vi) "SFTOS Configuration Guide Version 2.5.3.0 August 2008 Edition" (August 2008)" [DELL-ANETSUB00122759]

vii) "FTOS Command Line Interface Reference Version 5.3.1.0 May 2004" (May 2004) [DELL-ANETSUB00123073]

viii) "Dell Networking N-Series N1500, N2000, N3000, and N4000 Switches CLI Reference Guide Version 6.3.0.0 and Later" (Jan 2016) [DELL-ANETSUB00129345]

I also considered: DELL-ANETSUB00114148, CSI-CLI-04785577.

263. I have also reviewed the deposition transcript of Dell, Inc. and its corporate witness, Dell Senior Vice-President Gavin Cato, to prepare this Report.

264. Based on my review of Dell and Force10 materials, it is my opinion that Dell and Force10 networking products, specifically Ethernet switches, support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

265. As Dell explains in its "Dell Networking N-Series N1500, N2000, N3000, and N4000 Switches CLI Reference Guide," which bears a May 2015 date, the Dell

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"Command Line Interface (CLI) is a network management application operated through an ASCII terminal without the use of a Graphic User Interface (GUI) driven software application. By directly entering commands the user has greater configuration flexibility. The CLI is a basic command-line interpreter similar to the UNIX C shell." [ARISTANDCA13242587 at Page 95] (2015 Dell CLI Manual).

266. The same Dell manual further describes the CLI commands, modes, and hierarchies used in the Dell CLI as follows: "Since the set of CLI commands is very large, the CLI is structured as a command-tree hierarchy, where related command sets are assigned to command modes for easier access. At each level, only the commands related to that level are available to the user and only those commands are shown in the context sensitive help for that level." [ARISTANDCA13242587 at Page 226] (2015 Dell CLI Manual). This description equally applies to the Cisco CLIs at issue in this lawsuit.

267. The Dell networking products I analyzed for this Report support the following specific command modes and prompts, which are the same or substantially similar to the command modes supported in the disputed Cisco CLIs and the Arista EOS CLI in both their names and functionality, and have supported such command modes and prompts since at least May 2003:

Cisco Command Mode	Cisco Command Prompt[70]	Dell Command Mode	Dell Command Prompt
User EXEC	router> switch>	User EXEC	console>
Privileged EXEC	router# switch#	Privileged EXEC	console#

[70] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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Global Configuration	router(config)# switch(config)#	Global Configuration	console(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	console(config-if)#[71]

See Second Amended Complaint ¶ 54 (showing the relevant Cisco IOS command modes and prompts); Cisco's Response to Arista Interrogatory No. 2, Exh. C (showing the relevant command modes and prompts from Cisco IOS, IOS-XE, IOS XR, and NX-OS); *see also*

[DELL-ANETSUB00122116 at Pages 229-232] (May 2003 Dell CLI Manual) (CLI Command Modes); [DELL-ANETSUB00122372 at Pages 57-60] (2006 Dell CLI Manual (CLI Command Modes); [ARISTANDCA13242587 at Pages 226-240] (2015 Dell CLI Manual) (CLI Command Modes).

268. The May 2003 "Dell™ PowerConnect™ 3324/3348 Switch CLI Guide" describes these four command modes as follows: "To assist in configuring devices, the CLI command-line interface is divided into different command modes. Each command mode has its own set of specific commands. ... The standard order to access these modes is as follows: User EXEC Mode, Privileged EXEC Mode, Global Configuration Mode, Interface Configuration Mode." [DELL-ANETSUB00122116 at Page 229]. The 2003 Dell CLI manual further explains:

i) "When starting a session, the User EXEC Mode is the initial mode. Only a limited subset of commands are available in User EXEC

[71] The 2015 Dell CLI manual supports multiple Interface Configuration prompts depending on the particular interface. All use the prompt "console(config-if-*interface*)#" where *interface* will indicate the particular interface, such as VLAN, Gigabit Ethernet, etc. *See* [ARISTANDCA13242587 at Page 238-239] (2015 Dell CLI Manual). This is substantially similar—if not identical—to the Arista EOS CLI command prompt for Interface Configuration command mode.

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Mode. This level is reserved for tasks that do not change the configuration. To enter the next level, the Privileged EXEC Mode, a password is required."

ii) "The Privileged EXEC Mode gives access to commands that are restricted on EXEC Mode and provides access to the device Configuration Mode."

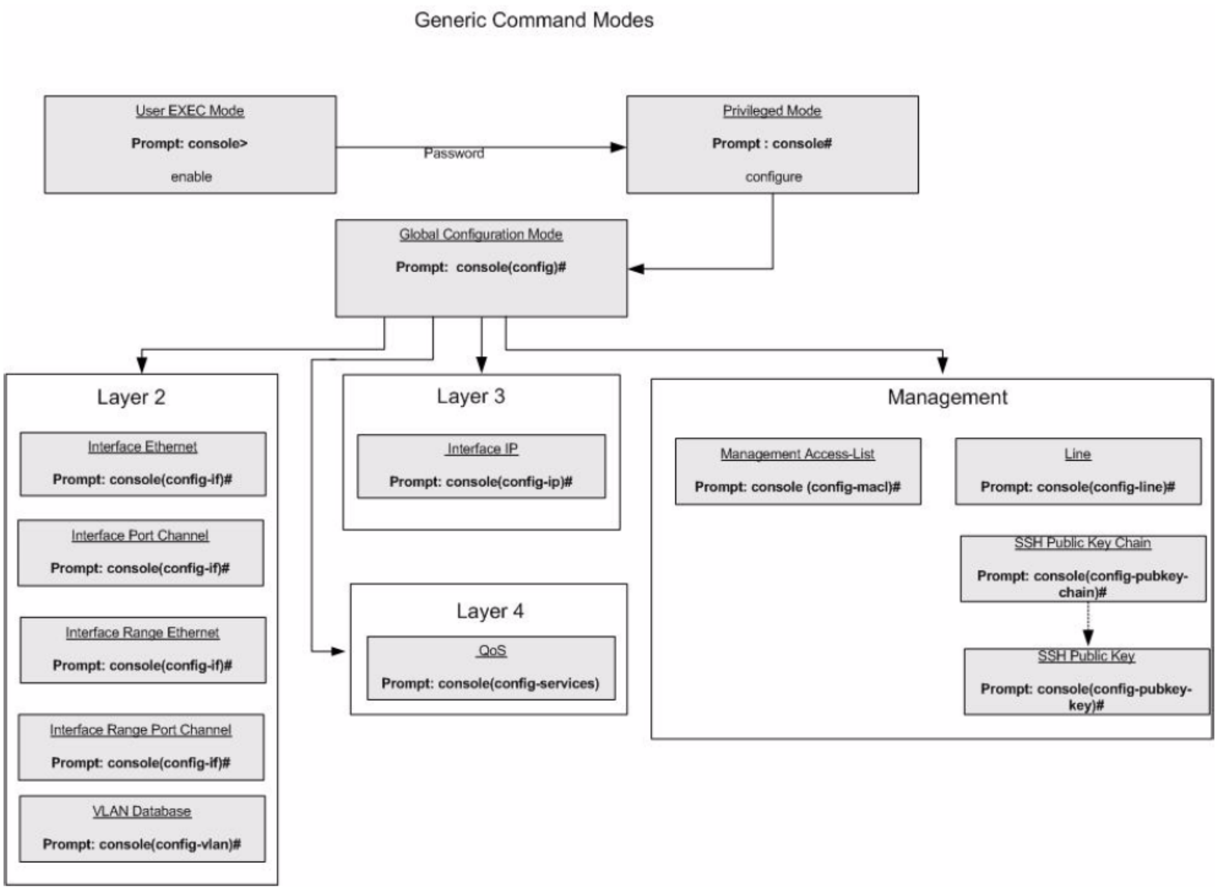
iii) "The Global Configuration Mode manages the device configuration on a global level. For specific interface configurations, enter the next level, the Interface Configuration Mode."

iv) "The Interface Configuration Mode configures specific interfaces in the device."

[DELL-ANETSUB00122116 at Page 229-230].

269. A graphical depiction of the relationships between these various command modes is clearly depicted in the following diagram from the August 2006 Dell™ PowerConnect™ 5324 Systems CLI Reference Guide.

EXPERT REPORT OF JOHN R. BLACK, JR.



[DELL-ANETSUB00122372 at 57].

270. The operation of these different command modes (User EXEC, Privileged EXEC, Global Configuration, and Interface Configuration) remained substantially the same in Dell's CLI from 2003 through to the present, and are substantially the same command modes in all relevant respects, including their associated prompts and functionality, as the Cisco CLI and Arista CLI command modes disputed in this lawsuit. [DELL-ANETSUB00122116 at Pages 229-232] (2003 Dell CLI Manual) (CLI Command Modes"); [DELL-ANETSUB00122372 at Pages 57-60] (2006 Dell CLI Manual (CLI Command Modes); [ARISTANDCA13242587 at Pages 226-240] (2015 Dell CLI Manual) (CLI Command Modes).

271. The Dell CLI also supported several additional CLI features shared with

the disputed Cisco and Arista CLIs, including:

i) The Dell PowerConnect CLI as early as May 2003 featured "help" functionality that is similar to help functionality in Cisco CLIs and in the Arista EOS CLI. As described below in the excerpt from the 2003 Dell manual, the user could access this functionality by typing a "?" into the CLI in various circumstances.

Commands are entered manually on the CLI. To see the available commands for each Mode or within an Interface Configuration context, the CLI provides commands for displaying available commands, command syntax requirements and in some instances parameters required to complete the command. The standard command requesting help is the ?.

There are two instances where the help information can be displayed:

- **Keyword lookup**—Enter the character ? in place of a command. A list of all commands and corresponding help messages are displayed.
- **Partial keyword lookup**—If a command is incomplete and the character ? is entered in place of a parameter, the matched parameters for this command are displayed.

[DELL-ANETSUB00122116 at Pages 232-233]. This context-sensitive "help" functionality remains present in the current Dell N-Series CLI as of May 2015. [ARISTANDCA13242587 at Pages 213-214] (2015 Dell CLI Manual).

ii) The Dell PowerConnect 3324/3348 CLI as early as May 2003 supported "command completion" functionality, which is found in the disputed Cisco CLI and Arista CLI:

Command Completion

When you type enough characters to identify a unique command, that command appears even if not complete. You can type the first few characters of a command to display all commands that begin with those characters. Press <Tab> repeatedly to move through the list to the correct command. For example, typing `history s` displays the command **history size**. Typing `history` displays the **history** and **history size** commands. To select **history size**, press <Tab> twice and then press <Enter>.

[DELL-ANETSUB00122116 at Pages 233-234]. This "command completion" functionality also remains present in the current Dell N-Series CLI as of May 2015. [ARISTANDCA13242587 at Page

216] (2015 Dell CLI Manual).

iii) The current Dell N-Series CLI as of May 2015 also supports the use of "short form" CLI commands, which is another CLI feature supported in both the disputed Cisco CLI and Arista CLI. The "short form" CLI functionality is described in the excerpt from the May 2015 Dell N-Series Switches CLI Reference Guide below:

Short Form Commands

The CLI supports the short forms of all commands. As long as it is possible to recognize the entered command unambiguously, the CLI accepts the short form of the command as if the user typed the full command.

[ARISTANDCA13242587 at Page 216] (2015 Dell CLI Manual).

iv) The Dell PowerConnect 3324/3348 CLI as early as May 2003 also used a "no" CLI command prefix to negate the functional effect of certain CLI commands. This functionality is also supported in the disputed Cisco CLIs and Arista CLI. A description of this common CLI functionality is shown in the excerpt below from the May 2003 Dell PowerConnect 3324/3348 CLI Manual:

Negating the Effect of Commands

Many configuration commands use the prefix keyword **no** to cancel a command or reset the configuration to the default value. This guide describes the negation effect for all applicable commands.

[DELL-ANETSUB00122116 at Page 233]. This use of a "no" prefix to negate CLI command functionality remains present in the current Dell N-Series CLI as of May 2015.

[ARISTANDCA13242587 at Page 215] (2015 Dell CLI Manual).

272. I have also reviewed several user manuals for Force10 networking product, including Force10 manuals that predate Dell's acquisition of Force10. Based on

my analysis of those Force10 materials, it is my opinion that the following command modes and prompts supported by the Force10 CLI are the same or substantially similar to the command modes supported in Cisco CLIs and the Arista EOS CLI:

Cisco Command Mode	Cisco Command Prompt[72]	Force10 Command Mode	Force10 Command Prompt
User EXEC	router> switch>	EXEC (2004)	Force10>
		User Exec (2008+)	hostname >
Privileged EXEC	router# switch#	EXEC privilege (2004)	Force10#
		Privileged Exec (2008+)	hostname #
Global Configuration	router(config)# switch(config)#	CONFIGURATION (2004)	Force10(conf)#
		Global Config (2008+)	hostname (Config)#
Interface Configuration	router(config-if)# switch(config-if)#	INTERFACE (2004)	Force10(conf-if)#
		Interface Config (2008+)	hostname (Interface ifnumber)# Specific interfaces (*e.g.* VLAN): hostname (conf-if-vl-vlan-id)#

See Second Amended Complaint ¶ 54 (showing the relevant Cisco IOS command modes and prompts); Cisco's Response to Arista Interrogatory No. 2, Exh. C (showing the relevant command modes and prompts from Cisco IOS, IOS-XE, IOS XR, and NX-OS);

[72] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

see also

[DELL-ANETSUB00123073 at Pages 40-44] (2004 Force10 CLI Manual); [DELL-ANETSUB00122759 at Page 39] (2008 Force10 CLI Manual; [DELL-ANETSUB00026077 at Page 28-33] (2011 Dell Force10 Command Reference).

273. Like the Dell CLI, the Force10 CLI also shared common CLI functionality with the disputed Cisco CLIs and Arista EOS CLI:

i) For example, like the disputed Cisco CLIs and Arista EOS CLI, the Force10 CLI as early as 2004 supported a context-specific "help" system where the user would enter a "?" at the command prompt or after a keyword. [DELL-ANETSUB00123073 at Page 41] (2004 Force10 CLI Manual). That functionality remained in the Force10 CLI up to the time of its acquisition by Dell in 2011. [DELL-ANETSUB00026077 at Page 27].

ii) The Force10 CLI as early as 2004 also supported command completion functionality, just like the disputed Cisco CLIs and Arista EOS CLI. As the 2004 Force10 CLI manual described: "You can use partial CLI keywords. For example, you can type conf for the configure terminal command. … You can use the TAB key to complete keywords in commands." [DELL-ANETSUB00123073 at Pages 41-42] (2004 Force10 CLI Manual). That functionality remained in the Force10 CLI up to the time of its acquisition by Dell in 2011. [DELL-ANETSUB00026077 at Page 26].

iii) In addition, like the disputed Cisco CLIs and Arista EOS CLI, the Force10 CLI as early as 2004 supported the "no" keyword in front of CLI commands, as described in the excerpt below from the 2004 Force10 CLI manual:

Using the Keyword No

> To disable, delete, or return to default values, use the no form of the CLI commands. For most commands, if you type the keyword **no** in front of the command syntax, you will disable that command or delete it from the running configuration. In this manual, the no form of the CLI is discussed in the Command Syntax portion of the CLI description.

[DELL-ANETSUB00123073 at Pages 43] (2004 Force10 CLI Manual). That functionality remained in the Force10 CLI up to the time of its acquisition by Dell in 2011. [DELL-ANETSUB00026077 at Pages 24-25] ("Almost every configuration command has a 'no' form. In general, use the 'no' form to reverse the action of a command or reset a value to the default.") (2011 Dell Force10 Command Reference).

274. The Dell and Force10 networking products I analyzed for this Report also support hundreds of industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Dell and Force10 networking equipment CLIs and Cisco CLIs is provided in **Appendix H.DE**. As shown in that detailed analysis, Dell (including Force10 Networks, which Dell acquired) supported at least 268 of the same Cisco CLI commands that are disputed in this lawsuit.

275. I undertook a careful analysis of the Dell and Force10 CLIs in order to better understand the nature of the similarity between those CLIs and the CLIs in use by

Cisco products. I will describe here the approach I took, the results I obtained, and my opinion on the meaning of those results.

276. My objective here was to measure the level of similarity between the collection of CLI commands supported by Cisco devices and those supported by Dell. My first goal was to collect a list of CLI commands for each vendor. Some Cisco products provide a CLI command “show parser dump all” which elicits a list of all CLI commands valid on the given device. As noted earlier in this Report, unfortunately when I issued this command on my Cisco 3725 router, the device crashed. I therefore resorted to Cisco user manuals as a source of CLI command listings.

277. I started with a set of 21 manuals produced by Cisco: 11 of these were for the Catalyst 6500 switch, 7 were for the Nexus 7000 switch, and one was for a Cisco 3750 switch. The specific manuals were provided in PDF and are listed earlier in this Report.

278. I then used a free public-domain tool called “pdf2txt”[73]to extract the raw text from the PDF. With the resulting 21 text files, I then used a script to extract the Cisco CLI commands. Some of these CLI commands were quite simple, such as “ntp authenticate”

ntp authenticate

To enable Network Time Protocol (NTP) authentication, use the **ntp authenticate** command in the global configuration mode. To disable NTP authentication, use the **no** form of this command.

ntp authenticate

no ntp [authenticate]

279. Here, a Cisco user would enter Global Configuration mode and then type

[73] See http://www.unixuser.org/~euske/python/pdfminer/

"ntp authenticate" as show in the manual screenshot above. In order to reverse the effect of this command, the user would type "no ntp authenticate". As explained above, the word "authenticate" in the latter case is optional. This means that "no ntp" alone is also a valid command (and would serve to disable all of the Network Time Protocol altogether for this device).

280. While many Cisco IOS commands are as simple as this one, many others are significantly more complex. For example, consider the "clear ip bgp" command:

clear ip bgp ipv6

To reset Border Gateway Protocol (BGP) connections using hard or soft reconfiguration for IPv6 address family sessions, use the **clear ip bgp ipv6** command in privileged EXEC mode.

clear ip bgp [**vrf** *vrf-name*] **ipv6** {**multicast**| **unicast**} *autonomous-system-number* [**in** [**prefix-filter**]| **out**| **slow**| **soft** [**in** [**prefix-filter**]| **out**| **slow**]]

281. As already noted above, a user cannot type the text given in the manual screenshot just given. Instead, we apply the rules for brackets and braces and the pipe symbol. So, we must start the command with "clear ip bgp"; we can then optionally include the keyword "vrf" followed by a vrf-name (which is chosen by the user, as suggested by the italic font). Then the keyword "ipv6" is required followed by either "multicast" or "unicast" (but not both). Then the autonomous system number follows (also assigned by the user). After this, all further keywords are optional, as indicated by the brackets surrounding them.

282. It is a basic mathematical fact that if we have a command syntax documented in the form "command [a] [b] [c]" there are 8 actual valid commands that arise from that documentation: (1) <u>command</u>, (2) <u>command a</u>, (3) <u>command b</u>, (4) <u>command c</u>, (5) <u>command a b,</u> (6) <u>command a c,</u> (7) <u>command b c,</u> and (8) <u>command a b</u>

c. In general, for any documented command syntax that takes the form "command [a1] [a2] … [an]" with n bracketed optional components, the total number of valid CLI command will be 2^n. This means a fairly short documented command syntax could embody thousands or millions of actual valid CLI commands. Additionally, some documented commands place no explicit limit on the number of words that can be given as part of a valid CLI command:

neighbor bmp-activate

To activate the BGP Monitoring Protocol (BMP) monitoring for a BGP neighbor, use the **neighbor bmp-activate** command in router configuration mode. To deactivate the BMP monitoring for a BGP neighbor, use the **no** form of this command.

neighbor {*ipv4-addr* | *neighbor-tag* | *ipv6-addr*} **bmp-activate** {**all** | **server** *server-number-1* [**server** *server-number-2* ... [**server** *server-number-n*]]}

no neighbor {*ipv4-addr* | *neighbor-tag* | *ipv6-addr*} **bmp-activate**

283. Here the ellipsis ("...") indicates that the user can type "server" followed by a (user-specified) server-name as many times as he/she wishes. Therefore, the number of valid CLI commands is theoretically infinite.[74]

284. Unfortunately, all of this serves to complicate the analysis of the Cisco CLI "set of valid commands." I decided to do the following: (1) For each documented command syntax, I expanded it into all valid commands and saved these to a file. (2) If a documented command syntax gave rise to too many valid commands, I omitted that command from the list. (3) Identifiers were left in their literal form. (4) Typographical errors were hand-corrected when discovered, but almost certainly some got through to my final list. (5) Taking all commands that were generated from the preceding steps, I

[74] Of course the true number is limited by the fact that computers are finite devices and there is, therefore, a practical limit on the number of valid commands, but it's very, very large.

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then compiled a "master list" that contained a sorted ordering of these commands with duplicates removed.

285. Before proceeding, I give examples to explain some of the points above. A documented command syntax that gave rise to too many valid commands was "debug crypto condition":

debug crypto condition [**connid** *integer* **engine-id** *integer*] [**flowid** *integer* **engine-id** *integer*] [**gdoi-group** *groupname*] [**isakmp profile** *profile-name*] [**fvrf** *string*] [**ivrf** *string*] [**local** {**ipv4** *ip-address* | **ipv6** *ip-address*}] [**peer** [**group** *string*] [**hostname** *string*] [**ipv4** *ip-address* | **ipv6** *ip-address*] [**subnet** *subnet mask* | *ipv6-prefix*] [**username** *string*]] [**spi** *integer*] [**reset**] [**unmatched** [**engine**] [**gdoi-group**] [**ipsec**] [**isakmp**] [**username** *string*]]

286. Although I did expand this to all of its valid inflections, the total number of syntactically valid and complete commands, taking into account all possible combinations and permutations, was about 1.8 million. This was impractical and unwieldy, and therefore I preferred to omit this documented command from my analysis along with others like it.

287. I discovered a significant number of typographical errors during my analysis, some of which caused false commands to be generated during my analysis. Here, for example, two commands were erroneously concatenated in the user documentation:

accept-lifetime

To set the time period during which the authentication key on a key chain is received as valid, use the **accept-lifetime**command inkey chain key configuration mode. To revert to the default value, use the **no** form of this command.

accept-lifetime commandaccept-lifetime *start-time* {**infinite**| *end-time*| **duration** *seconds*}

no accept-lifetime [*start-time* {**infinite**| *end-time*| **duration** *seconds*}]

(My guess is that "command" is an internal formatted directive that accidentally got

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included in literal form.)

288. In this next example, taken from the Cisco 3750 manual, the brackets are not properly balanced, and therefore the entire documented command was discarded:

show mac address-table notification

Use the **show mac address-table notification** user EXEC command to display the MAC address notification settings for all interfaces or the specified interface.

show mac address-table notification {**change** [**interface** [*interface-id*] | **mac-move** | **threshold**}

289. Another error I found was the misspelling of keywords (a difficult-to-find error) within the Cisco user documentation. Here the keyword "ipv6" is misspelled as "iv6p":

show ipv6 bgp

To display entries in the Border Gateway Protocol (BGP) table, use the **show ipv6 bgp** command.

show iv6p bgp [*ipv6-addr* | *ipv6-prefix* [**longer-prefixes**]] [**received-paths**] [**regexp** *expression*] [**route-map** *map-name*] [**summary**] [**vrf** *vrf-name*]

290. After applying the steps just enumerated, I obtained about 290,000 CLI commands that could actually be issued to some Cisco device, under some version of IOS (or its variants) and be accepted as valid in the proper mode and command context. This is markedly more than claimed by any Cisco documents that I have seen, but this is due to the fact those documents generally count documented commands syntaxes rather than each individual valid, complete, and issuable command.

291. Next I incorporated 36 more Cisco manuals produced as text files; because I utilized the text files provided by Cisco, there was no need to first convert to text with the pdf2txt tool and I was able to immediately scrape these files for documented CLI commands. Applying the same methodology described above (with the same caveats) I

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obtained another approximately 219,000 valid CLI commands. Of course there was some redundancy between the first set of 21 manuals and this set, so upon combining the two sets and removing duplicates, I obtained a final collection of about 445,000 Cisco CLI commands.

292. I believe that every one of the commands I generated by this technique is "valid" in the sense that there is some Cisco product that exists or has existed that could be configured in such a way that issuing the given command would not result in an error. However, I note the following observations: (1) "identifiers" or "arguments" given literally in a valid command here would be replaced by a user-supplied value; the variability here therefore results in more, not fewer, valid CLI commands. (2) The 57 Cisco manuals I used are a small subset of the total number of Cisco-authored manuals and therefore almost certainly undercounts the true number of CLI commands available. (3) Some documented commands were omitted because they either had typographical errors or would lead to the generation of an unwieldy number of valid commands; excluding these commands clearly reduced the total number of commands from the "true" number. In short, our roughly 445,000 Cisco CLI commands vastly under-represents the set of all valid Cisco CLI commands.

293. I next applied the same process just described to the set of 7 produced manuals from Dell, which are listed above in this section. This yielded about 265,000 valid commands that could be issued against some device sold by Dell (including those sold by Force10 prior to the Dell acquisition). Once again, this is almost certainly an undercount of the total command-set for Dell products given that certain commands had to be omitted, and given that there are more Dell and Force10 manuals than just the seven

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produced.

294. Finally, I ran a comparison between these two sets of CLI commands to see which commands valid Cisco commands are also valid Dell commands. The comparison required that a given Cisco CLI command exactly match some corresponding Dell CLI command. If two commands varied in minor ways, such as the addition of a hyphen or the omission of an "s" at the end of a word, the commands would not be considered a match.

295. The result of my analysis was a list of over 1600 CLI commands that could be typed into either CLI, Cisco or Dell, and would be accepted (presumably) without error. The list of these commands can be found in **Appendix I**.

296. My opinion that Dell's networking products support an industry-standard CLI is supported by the sworn deposition testimony of Dell's own corporate witness, as well as its product materials. At the deposition of Dell's corporate witness, Mr. Gavin Cato, the witness discussed his familiarity with both the Dell and Force10 CLIs, as well as other CLIs using by networking vendors in the industry, including Extreme Networks' and Enterasys Networks' CLIs (Mr. Cato was previously employed by Extreme Networks and testified that he had responsibilities pertaining to the Extreme CLI), and Brocade, Cisco, Arista, NETGEAR, and Juniper's CLIs for their switching products. *See* Dell Corp. Dep Tr. (Cato) at 21-40. Mr .Cato also confirmed that he interacted with customers—both at Dell and while employed at Extreme Networks—and became familiar with what customers expected in terms of CLI functionality. *Id.*

297. Mr. Cato testified that, based on his experience working directly with customers that use switching equipment, and his own experience working with different

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vendors' CLIs for their switching equipment, that customers "desire … to have a similar look and feel for the [routing and switching] products and the interactions with the products for their technicians." Cato Dep. Tr. at 34-39. He also confirmed that Dell customers expect that the Dell CLI would support the command modes that customer technicians are familiar with. *Id.* at 37-38. To determine what Dell networking customers expect, Mr. Cato also confirmed that Dell looked at and analyzed "the most familiar mechanisms for the customer" to ensure consistency across Dell products, and that customers have sometimes required particular commands and modes and sequences in the Dell CLI to be supported. *Id.* at 37-39. One such example is the Dell CLI's support of "show" commands. *Id.* at 39-41.

298. Finally, Dell's corporate witness confirmed that the process for adding new CLI commands to Dell's CLI involves ensuring that industry standards (such as those approved by the IETF and IEEE) and customer expectations are considered and met. *See* Dell Corp. Dep Tr. (Cato) at 34-37 and 41-55. In particular, Mr. Cato provided a concrete illustration of how a particular customer ([redacted] requested that both the inputs and outputs of the CLI would have to match industry-standard CLI syntax and formatting for both command inputs ***and outputs*** due to scripting requirements—and in particular, scripts that had already been written for Cisco IOS products. *Id.* at 46-55. Mr. Cato also noted that Extreme, Cisco, and Arista—like Dell—supported at least aspects of the industry standard CLI. *Id.* at 94-96.

299. Mr. Cato also confirmed that Dell and Force10 product materials mentioning an industry-standard or Cisco-like CLI were describing the same industry-standard CLI he described in his deposition testimony. *See* Dell Corp. Dep Tr. (Cato) at

34-58, and 100-110; Exhs. 952 to 953, and Exhs. 957-959. Mr. Cato confirmed that the "industry standard CLI" referred to "the practices in the industry, in general, relative to the CLI and the implementation of the CLI in the industry" and that "if you are familiar with the industry-standard aspects of the Cisco [device], you would be familiar with the industry-standard aspects of the Dell switch, or the Force10 switch in this case." *Id.* at 57-58, 105. This is consistent with my understand of the industry-standard CLI, and is reflected in the substantial number of overlapping commands shared by the Dell CLI and the disputed CLI commands in this litigation, as well as the substantially higher number of overlapping commands shared by the Dell CLI and Cisco CLI.

300. Finally, Mr. Cato confirmed that Dell, in promotional videos on its YouTube channel, promoted the similarities between the Dell CLI and the Cisco IOS CLI. *See* Dell Corp. Dep Tr. (Cato) at 96-100, Exh. 956. All of the foregoing evidence provided by Dell add further support to my opinion that the Dell and Force10 CLIs support an industry-standard CLI.

7. D-Link CLI

301. Founded in 1986, D-Link Corporation sells business class switches, including unmanaged and managed Gigabit Ethernet and Fast Ethernet switches that support Layer 2, Layer 2+, and Layer 3 switching functionality. *See* http://us.dlink.com/about/history-of-d-link/; http://us.dlink.com/product-category/business-solutions/switching/.

302. I understand that D-Link produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to D-Link networking products, but only very recently at the close of fact discovery. I also

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understand that a D-Link representative executed a sworn declaration attesting that the documents produced by D-Link under the subpoena are authentic copies of documents created in the ordinary course of business. I expect most if not all of the D-Link produced documentation will be identical to the documentation cited below, and for D-Link and other vendor documents produced shortly before this Report came due, I reserve the right to rely on the third-party vendor produced user documentation, particularly if they are the same or substantially the same as documentation already produced in this lawsuit.

303. I have analyzed D-Link product manuals for several of its networking products for purposes of this Report. Those product manuals include:

i) "D-Link Router Command Line Interface Reference Manual" (Aug. 2004) [ARISTANDCA13245259]

ii) "D-Link xStack DXS-3200 Series CLI Reference Guide" (Sept. 2005) [ARISTANDCA00279166]

iii) "D-Link xStack DES-3228PA Layer 2 Stackable 10/100Mbps Ethernet Switch" (Dec. 2006) [ARISTANDCA00278655]

iv) "D-Link DES-7200 CLI Reference Guide" (Jan. 2012) [ARISTANDCA13247737]

v) "DXS-3600 Series Layer 3 Managed 10Gigabit Ethernet Switch CLI Reference Guide" (Oct. 2013) [ARISTANDCA13250221]

vi) "D-Link DGS-1510 Series Gigabit Ethernet SmartPro Switch CLI Reference Guide" (Oct. 2013) [ARISTANDCA13251549]

vii) "D-Link xStack® DGS-3620 Series Layer 3 Managed Stackable

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Gigabit Switch CLI Reference Guide" (Nov. 2013)

[ARISTANDCA13252251]

I also considered: ARISTANDCA13245936, ARISTANDCA13247171, ARISTANDCA13246835.

304. Based on my review of D-Link materials, it is my opinion that D-Link networking products, including their Ethernet switches, support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

305. D-Link Ethernet switches supported the same four command modes that are disputed in this litigation as early as 2005,[75] with substantially the same—if not identical—prompts for each command mode: (1) User EXEC, (2) Privileged EXEC, (3) Global Configuration, and (4) Interface Configuration. [ARISTANDCA00279166 at Pages 13-15] (Sept. 2005 D-Link DXS-3200 Series CLI Guide). A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by the D-Link CLI as of 2005 is shown below:

Cisco Command Mode	Cisco Command Prompt[76]	D-Link CLI Command Mode	D-Link CLI Command Prompt
User EXEC	router>	User EXEC	Console>

[75] I note that D-Link produced several command reference manuals shortly before the close of fact discovery, and I have not had the opportunity to review all of those manuals given the late production of that material. I reserve all rights to use those recently produced third-party manuals from D-Link as part of my opinion, and if those manuals show a usage date (and scope) of the asserted CLI elements earlier than the dates stated (or greater than the amounts stated) in my Report, I will update my opinion accordingly.
[76] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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	switch>		
Privileged EXEC	router# switch#	Privileged EXEC	Console#
Global Configuration	router(config)# switch(config)#	Global Configuration	Console(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	Console(config-if)#

[ARISTANDCA00279166 at Pages 13-15, 42] (Sept. 2005 D-Link DXS-3200 Series CLI Guide).

306. The operation of these four command modes in the D-Link CLI is described in the 2005 D-Link CLI Reference Manual as follows: "When starting a session, the initial mode is the User EXEC mode. Only a limited subset of commands are available in User EXEC mode. This level is reserved for tasks that do not change the configuration. To enter the next level, the Privileged EXEC mode, a password is required. The Privileged EXEC mode gives access to commands that are restricted on User EXEC mode and provides access to the device Configuration mode. The Global Configuration mode manages the device configuration on a global level. The Interface Configuration mode configures specific interfaces in the device." [ARISTANDCA00279166 at Page 13] (Sept. 2005 D-Link DXS-3200 Series CLI Guide). These modes of operation are substantially the same as the accused command modes in the Arista EOS CLI.

307. As of late 2013, D-Link switches still supported these same four modes:

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The command-line interface has a number of command modes. There are three basic command modes:

- **User EXEC Mode**
- **Privileged EXEC Mode**
- **Global Configuration Mode**

All other sub-configuration modes can be accessed via the **Global Configuration Mode**.

Interface Configuration Mode

> Interface configuration mode is used to configure the parameters for an interface or a range of interfaces. An interface can be a physical port, VLAN, or other virtual interface. Thus, interface configuration mode is distinguished further according to the type of interface. The command prompt for each type of interface is slightly different.

[ARISTANDCA13250221 at Pages 7-10] (Oct. 2013 D-Link DXS-3600 CLI Guide).

The associated prompts for these four modes were also the same as used by D-Link in 2005, as shown above. [ARISTANDCA13250221 at Pages 7-10, 74] (Oct. 2013 D-Link DXS-3600 CLI Guide).

308. The D-Link CLI at least as of 2005 also supported several other common CLI features that are present in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key. *See* [ARISTANDCA00279166 at Page 17] (Sept. 2005 D-Link DXS-3200 Series CLI Guide).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [ARISTANDCA00279166 at Pages 16-17] (Sept. 2005 D-Link DXS-3200 Series CLI Guide).

iii) Use of a "no" keyword before a CLI command to negate the effect of the command. *See* [ARISTANDCA00279166 at Page 17] (Sept. 2005 D-Link DXS-3200 Series CLI Guide).

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309. The D-Link networking products I analyzed for this Report also support hundreds of industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the D-Link networking equipment CLIs and Cisco CLIs is provided in **Appendix H.DL**. As shown in that detailed analysis, D-Link has supported at least 305 of the same Cisco CLI commands that are disputed in this lawsuit—well over half of the disputed commands at issue in this case.

8. Edge-Core Networks CLI

310. Edge-Core Networks Corporation, which was spun-off from Accton Technology Group in 2010, sells enterprise-level, service provider/carrier Ethernet, LAN/connectivity, and home security networking equipment, including Layer 2 and Layer 3 Gigabit Ethernet switches. *See* http://www.edge-core.com/company.php; http://www.edge-core.com/products.php.

311. I understand that Edge-Core produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to Edge-Core networking products. I also understand that a Edge-Core representative executed a sworn declaration attesting that the documents produced by Edge-Core under the subpoena are authentic copies of documents created in the ordinary course of business.

312. I have analyzed Edge-Core product manuals for several of its networking products for purposes of this Report. Those product manuals include:

i) "Edge-Core 12/28-Port Gigabit Ethernet Layer 2 Switch … Software Release v1.0.0.24 CLI Reference Guide" (Apr. 2013)

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[EC002593]

ii) "Edge-Core 12-Port Gigabit Ethernet Layer 2 Switch ECS4510-12PD Software Release v1.0.2.0 CLI Reference Guide" " (Aug. 2013) [EC001175]

iii) "Edge-Core 48-Port 10G Layer 3 Switch ECS5610-52S Software Release v1.0.0.0 CLI Reference Guide" (Aug. 2013) [EC003305]

iv) "Edge-Core CLI Command Reference 48-Port Gigabit Ethernet Top-of-Rack Switch AS4600-54T DCSS Software v2.1.10.0" (Sept. 2013) [EC000001]

v) "Edge-Core AS5600-52X 48-Port 10G Top-of-Rack Switch Software Release v1.2.4.0 CLI Reference Guide" (Nov. 2013) [EC000499]

vi) "Edge-Core ECS4620-28T/P/F … 28/52-Port Layer 3 Stackable GE Switch Software Release v1.2.2.0 CLI Reference Guide" (Dec. 2014) [EC004411]

vii) "Edge-Core ECS2100-10T/PE/P ECS2100-28T/P/PP 10/28-Port Web-Smart Pro Gigabit Ethernet Switch Software Release v1.1.2.0 CLI Reference Guide" (Jan. 2016) [EC001947]

313. Based on my review of Edge-Core materials, it is my opinion that Edge-Core networking products, including their Ethernet switches, support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI

commands, command hierarchies, command modes, and command prompts.

314. Edge-Core Ethernet switches supported substantially the same four command modes that are disputed in this litigation as early as 2013, with substantially the same—if not identical—prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by the Edge-Core CLI as of 2013 is shown below:

Cisco Command Mode	Cisco Command Prompt[77]	Edge-Core CLI Command Mode	Edge-Core CLI Command Prompt
User EXEC	router> switch>	Normal EXEC	Console>
Privileged EXEC	router# switch#	Privileged EXEC	Console#
Global Configuration	router(config)# switch(config)#	Global Configuration	Console(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	Console(config-if)#

[EC002593 at Pages 45-48, 68-74] (Apr. 2013 Edge-Core CLI Guide).

315. As the April 2013 Edge-Core CLI Guide explains: "When you open a new console session on the switch … the system enters the Normal Exec command mode (or guest mode), displaying the 'Console>' command prompt. Only a limited number of the commands are available in this mode. You can access all commands only from the Privileged Exec command mode (or administrator mode). To access Privilege Exec mode, open a new console session with the user name and password 'admin.' The system will now display the 'Console#' command prompt." [EC002593 at Page 69] (Apr. 2013

[77] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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Edge-Core CLI Guide). These Edge-Core command modes are substantially the same as the "User EXEC" and "Privileged EXEC" command modes supported by the disputed Cisco CLIs and the Arista EOS CLI.

316. The April 2013 Edge-Core CLI Guide further explains: "The configuration commands are organized into different modes: … Global Configuration - These commands modify the system level configuration, and include commands such as hostname and snmp-server community. … Interface Configuration - These commands modify the port configuration such as speed-duplex and negotiation." [EC002593 at Pages 45, 69-70] (Apr. 2013 Edge-Core CLI Guide). These Edge-Core command modes are substantially the same as the "Global Configuration" and "Interface Configuration" command modes supported by the disputed Cisco CLIs and the Arista EOS CLI.

317. The Edge-Core CLI as of 2016 still supports these command modes and prompts described above. *See* [EC001947 at Pages 66-68] (Jan. 2016 Edge-Core CLI Guide).

318. The Edge-Core CLI at least as of 2013 also supported several other common CLI features that are present in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key. *See* [EC002593 at Page 65] (Apr. 2013 Edge-Core CLI Guide).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [EC002593 at Page 66-68] (Apr. 2013 Edge-Core CLI Guide).

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iii) A "minimum abbreviation" feature, which means: "The CLI will accept a minimum number of characters that uniquely identify a command. For example, the command 'configure' can be entered as con. If an entry is ambiguous, the system will prompt for further input." *See* [EC002593 at Page 65] (Apr. 2013 Edge-Core CLI Guide).

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See* [EC002593 at Page 68] (Apr. 2013 Edge-Core CLI Guide).

319. The Edge-Core networking products I analyzed for this Report also support hundreds of industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Edge-Core networking equipment CLIs and Cisco CLIs is provided in **Appendix H.EC**. As shown in that detailed analysis, Edge-Core has supported at least 223 of the same Cisco CLI commands that are disputed in this lawsuit.

9. Ericsson and Redback Networks CLI

320. Founded in 1876, Ericsson offers a wide range of products and services, including IP networking and transport products such as the Ericsson SmartEdge Multi-Service Edge Router product line. *See* http://www.ericsson.com/thecompany/company_facts/history; http://www.ericsson.com/thecompany/company_facts/businesses; http://www.ericsson.com/ourportfolio/products/ip-network-and-transport; http://www.ericsson.com/ourportfolio/products/se-

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family?nav=productcategory004%7Cfgb_101_0192.

321. Ericsson announced its acquisition of Redback Networks in December 2006, which thereafter became a subsidiary of Ericsson. *See* http://www.ericsson.com/news/1094314. Redback was founded 1996 in San Jose, CA, and sold multi-service edge routing products. The "SmartEdge" line of router were sold by Redback prior to its acquisition by Ericsson. *See, e.g.*, ARISTANDCA13360216 (Dec. 2005 Redback Networks SmartEdge OS User Guide).

322. I have analyzed Ericsson and Redback product manuals for several of its networking products for purposes of this Report. Those product manuals include:

i) "Ericsson ESN212 and ESN204g CLI User Guide EDA 1200" (Mar. 2009) [ARISTANDCA13257362]

ii) "Ericsson ECN330-switch User Guide EDA Ethernet Layer 3 Switch" (June 2006) [ARISTANDCA13256136]

iii) "RedBack Networks Basic System Configuration Guide SmartEdge OS Release 5.0.3" (Dec. 2005) [ARISTANDCA13358934]

iv) "RedBack Networks Basic System Operations Guide SmartEdge OS Release 5.0.3" (Dec. 2005) [ARISTANDCA13359268]

v) "RedBack Networks IP Services and Security Configuration Guide SmartEdge OS Release 5.0.3" (Dec. 2005) [ARISTANDCA13359558]

vi) "RedBack Networks IP Services and Security Operations Guide SmartEdge OS Release 5.0.3" (Dec. 2005)

[ARISTANDCA13360216]

vii) "RedBack Networks Ports, Circuits, and Tunnels Configuration Guide SmartEdge OS Release 5.0.3" (Dec. 2005) [ARISTANDCA13360544]

viii) "RedBack Networks Ports, Circuits, and Tunnels Operations Guide SmartEdge OS Release 5.0.3" (Dec. 2005) [ARISTANDCA13361152]

ix) "RedBack Networks Routing Protocols Configuration Guide SmartEdge OS Release 5.0.3" (Dec. 2005) [ARISTANDCA13361534]

x) "RedBack Networks Routing Protocols Operations Guide SmartEdge OS Release 5.0.3" (Dec. 2005) [ARISTANDCA13362362]

323. Based on my review of Ericsson materials, it is my opinion that Ericsson and Redback Networks networking products, including their Ethernet switches, support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

324. Ericsson Ethernet switches supported substantially the same four command modes that are disputed in this litigation as early as 2006, with substantially the same—if not identical—prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by

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the Ericsson CLI as of 2006 is shown below:

Cisco Command Mode	Cisco Command Prompt[78]	Ericsson (2006) CLI Command Mode	Ericsson (2006) CLI Command Prompt
User EXEC	router> switch>	Normal EXEC	Console>
Privileged EXEC	router# switch#	Privileged EXEC	Console#
Global Configuration	router(config)# switch(config)#	Global Configuration	Console(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	Console(config-if)#

[ARISTANDCA13256136 at Pages 521-526] (June 2006 Ericsson Switch CLI Guide).

325. As the June 2006 Ericsson CLI Guide explains: "If the system is in Normal Exec command mode (or guest mode), displaying the Console> command prompt, only a limited number of the commands are available. All commands can only be accessed from the Privileged Exec command mode (or administrator mode). To access Privilege Exec mode, open a console session with the default user name and password admin. The system displays the Console# command prompt." [ARISTANDCA13256136 at Page 522] (June 2006 Ericsson Switch CLI Guide). These Ericsson command modes are substantially the same as the "User EXEC" and "Privileged EXEC" command modes supported by the disputed Cisco CLIs and the Arista EOS CLI.

326. The June 2006 Ericsson CLI Guide further explains: "The configuration commands are organized into different modes: … Global Configuration - These commands modify the system level configuration, and include commands such as

[78] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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hostname and snmp-server community. … Interface Configuration - These commands modify the port configuration such as speed-duplex and negotiation." [ARISTANDCA13256136 at Pages 523-524] (June 2006 Ericsson Switch CLI Guide). These Ericsson command modes are substantially the same as the "Global Configuration" and "Interface Configuration" command modes supported by the disputed Cisco CLIs and the Arista EOS CLI.

327. By 2009, the Ericsson CLI had become even more similar to the disputed command modes and prompts at issue in this litigation. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by the Ericsson CLI as of 2009 is shown below:

Cisco Command Mode	Cisco Command Prompt[79]	Ericsson (2009) CLI Command Mode	Ericsson (2009) CLI Command Prompt
User EXEC	router> switch>	User EXEC	esn212>
Privileged EXEC	router# switch#	Privileged EXEC	esn212#
Global Configuration	router(config)# switch(config)#	Global Configuration	esn212(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	esn212(config-if)#

[ARISTANDCA13257362 at 4-10] (Mar. 2009 Ericsson Switch CLI Guide). Note that "esn212" is the device name used in the Ericsson manual for the examples above.

328. Similarly, the Redback Networks CLI as of 2005 also supported similar command modes and prompts as those at issue in this litigation. A comparison of

[79] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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disputed Cisco command modes and prompts, and the command modes and prompts supported by the Redback Networks CLI as of 2005 is shown below:

Cisco Command Mode	Cisco Command Prompt[80]	Redback CLI Command Mode	Redback CLI Command Prompt
User EXEC	router> switch>	Exec (privilege level < 6)[81]	>
Privileged EXEC	router# switch#	Exec (privilege level 6+)	#
Global Configuration	router(config)# switch(config)#	Global Configuration	(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	(config-if)#

[ARISTANDCA13358934 at Pages 1-11 to 1-16] (Dec. 2005 Redback Networks Basic System Configuration Guide for SmartEdge OS).

329. As the December 2005 Redback Networks Basic System Configuration Guide for SmartEdge OS explains: "When a session is initiated, the CLI is set to the exec mode by default. The exec mode allows you to examine the state of the system and perform most monitoring, troubleshooting, and administration tasks using a subset of the available CLI commands. … Global configuration mode is the top-level configuration mode; all other configuration modes are accessed from this mode. … Command modes exist in a hierarchy; that is, you must access the higher-level command mode before you

[80] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.
[81] "The SmartEdge OS supports 16 different privilege levels for administrators and for commands. By default,
administrators are assigned an initial privilege level of 6; administrators can only issue commands that are assigned at the same level as their own privilege level or lower than their privilege level. Each command in the CLI is assigned a default privilege level. At a privilege level of 6 or higher, the prompt in the CLI displays a number sign (#) instead of an angle bracket (>)." [ARISTANDCA13358934 at Pages 1-15 to 1-16] (Dec. 2012 Redback Networks Basic System Configuration Guide for SmartEdge OS).

can access a lower-level command mode in the same chain.” [ARISTANDCA13358934 at Page 1-12] (Dec. 2005 Redback Networks Basic System Configuration Guide for SmartEdge OS). The exec mode prompt is either “>” or “#” depending on the user’s privilege level. *Id.* at Pages 1-15 to 1-16.

330. The Ericsson and Redback Networks CLIs also supported several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the “Tab” key. *See* [ARISTANDCA13358934 at Page 2-6] (Dec. 2005 Redback Networks Basic System Configuration Guide for SmartEdge OS); [ARISTANDCA13256136 at Page 518] (June 2006 Ericsson Switch CLI Guide).

ii) A context-sensitive help system triggered by entering the “?” character into the CLI. *See* [ARISTANDCA13358934 at Pages 2-5, and 2-10 to 2-11] (Dec. 2005 Redback Networks Basic System Configuration Guide for SmartEdge OS); [ARISTANDCA13256136 at Pages 519-520, 531] (June 2006 Ericsson Switch CLI Guide).

iii) A “partially typed commands” feature, which means: “In all modes, the system recognizes and accepts partially typed commands and keywords, provided that you have entered a sufficient text to be unique. For example, rather than typing configure, you can type conf and press Enter to enter configuration

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mode. However, if you enter the string con, an error is returned, because insufficient characters have been entered to distinguish between the configure command, and the context command." *See* [ARISTANDCA13358934 at Page 2-2] (Dec. 2005 Redback Networks Basic System Configuration Guide for SmartEdge OS); [ARISTANDCA13256136 at Page 518] (June 2006 Ericsson Switch CLI Guide) (describing the "minimum abbreviation" feature).

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See* [ARISTANDCA13358934 at Page 2-2] (Dec. 2005 Redback Networks Basic System Configuration Guide for SmartEdge OS)[82]; [ARISTANDCA13256136 at Page 521] (June 2006 Ericsson Switch CLI Guide).

331. The Ericsson and Redback Networks networking products I analyzed for this Report also support well over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Ericsson networking equipment CLI and Cisco CLIs is provided in **Appendix H.ER**. As shown in that detailed analysis, Ericsson has supported at least 157 of the same Cisco CLI commands that are disputed in this lawsuit.

332. I only had a limited number of Redback Networks user manuals for my analysis (cited above). A analysis of the Redback networking equipment CLI and Cisco

[82] As shown in this citation, the Redback Networks CLI also supported a "default" keyword, which when entered in front of a command would return a parameter or feature into the default state. [ARISTANDCA13358934 at Page 2-2] (Dec. 2005 Redback Networks Basic System Configuration Guide for SmartEdge OS). This is a feature shared found in the Cisco CLIs at issue in this case.

CLIs, based on that limited documentation, is provided in **Appendix H.RB**. As shown in that limited analysis, Redback supported at least 66 of the same Cisco CLI commands that are disputed in this lawsuit.

333. I note that Redback Networks' use of a "Cisco-like" was acknowledged by several Cisco engineers, including Mr. Phillip Remaker, who testified that he remembered "some companies" including Redback Networks using commands similar to Cisco's as early as "1998 or 1999." *See* Remaker Dep. Tr. at 150. Mr. Remaker's view is consistent with my analysis of Redback Networks' CLI.

10. Extreme Networks CLI

334. Extreme Networks, based in San Jose, California, sells a wide range of edge or core Ethernet switching products, including Fast Ethernet, Gigabit, and 10 Gigabit Ethernet switches. *See* http://www.extremenetworks.com/products/switching-routing; http://investor.extremenetworks.com/releasedetail.cfm?releaseid=790266.

335. In September 2013, Extreme Networks announced an agreement to acquire Enterasys Networks, a New Hampshire based provider of wired and wireless network infrastructure and security solutions. According to Extreme Network's press releases on this issue, the acquisition made Extreme Networks the fourth largest Ethernet networking vendor. *See* http://investor.extremenetworks.com/releasedetail.cfm?releaseid=790266; http://investor.extremenetworks.com/releasedetail.cfm?releaseid=803453.

336. I understand that Extreme Networks produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to Extreme Networks and Enterasys networking products. I also understand that

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a Extreme Networks representative executed a sworn declaration attesting that the documents produced by Extreme Networks under the subpoena are authentic copies of documents created in the ordinary course of business.

337. I have analyzed Extreme Networks and Enterasys product manuals for several of its networking products for purposes of this Report. Those product manuals include:

i) "Summit® WM3000 Series Controller CLI Reference Guide, Software Version 4.0" (Dec. 2009) [EXNET-ARISTA0054421]

ii) "Summit® WM3000 Series Controller and Altitude 4000 Series Access Point CLI Reference Guide Software Version 5.2" (Nov. 2011) [EXNET-ARISTA0057033]

iii) "Enterasys N-Series® CLI Reference Firmware Version 7.11" (Dec. 2011) [EXNET-ARISTA0047042]

338. Based on my review of Extreme Networks materials, it is my opinion that Extreme Networks networking products support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

339. Extreme Networks networking products supported substantially the same four command modes that are disputed in this litigation as early as 2009, with substantially the same—if not identical—prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes

and prompts supported by the Extreme Networks CLI as of 2009 is shown below:

Cisco Command Mode	Cisco Command Prompt[83]	Extreme Networks CLI Command Mode	Extreme Networks CLI Command Prompt
User EXEC	router> switch>	User Exec (or USER EXEC)	WMController>
Privileged EXEC	router# switch#	Privileged Exec (or PRIV EXEC)	WMController#
Global Configuration	router(config)# switch(config)#	Global Configuration	WMController(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	WMController(config-if)#

[EXNET-ARISTA0054421 at Pages 14, 24, 70, 139, 155, 235] (Dec. 2009 Extreme WM3000 CLI Guide).

340. As the December 2009 Extreme Networks CLI Guide explains: "A session generally begins in the USER EXEC mode (one of the two access levels of the EXEC mode). For security, only a limited subset of EXEC commands are available in the USER EXEC mode. This level is reserved for tasks that do not change the configuration of the controller (such as determining the current controller configuration). To access commands, enter the PRIV EXEC mode (the second access level for the EXEC mode). Once in the PRIV EXEC mode, enter any EXEC command. The PRIV EXEC mode is a superset of the USER EXEC mode. … Access the GLOBAL CONFIG mode from the PRIV EXEC mode. In GLOBAL CONFIG mode, enter commands that set general system characteristics. Configuration modes, allow you to change the running

[83] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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configuration. You can also access sub-modes from the global configuration mode." [EXNET-ARISTA0054421 at Page 24] (Dec. 2009 Extreme WM3000 CLI Guide); *see also id.* at Page 235 (discussing the "interface configuration mode"). The foregoing command modes in the Extreme CLI operate in substantially the same way as the disputed command modes in this litigation, and share the same command prompts.

341. The Extreme Networks CLIs also supported several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key. *See* [EXNET-ARISTA0054421 at Page 29] (Dec. 2009 Extreme WM3000 CLI Guide).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [EXNET-ARISTA0054421 at Pages 25-27] (Dec. 2009 Extreme WM3000 CLI Guide).

iii) An "abbreviate commands and keywords" feature, which means: "It is possible to abbreviate commands and keywords to allow a unique abbreviation. For example, 'configure terminal' can be abbreviated as config t. Since the abbreviated command is unique, the controller accepts the abbreviation and executes the command." *See* [EXNET-ARISTA0054421 at Page 27] (Dec. 2009 Extreme WM3000 CLI Guide).

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See* [EXNET-ARISTA0054421 at Page 27] (Dec. 2009 Extreme WM3000 CLI Guide).

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342. The Extreme Networks networking products I analyzed for this Report also support well over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Extreme Networks networking equipment CLIs and Cisco CLIs is provided in **Appendix H.EX**. As shown in that detailed analysis, Extreme Networks has supported at least 111 of the same Cisco CLI commands that are disputed in this lawsuit.

11. HP Enterprise CLI

343. Hewlett Packard Enterprise (HPE) is one of two companies created by the recent split of Hewlett-Packard Company. HPE, which was incorporated in 2015, is comprised of the former Hewlett-Packard Company's enterprise technology infrastructure, software and services businesses, while HP Inc. took over the former Hewlett-Packard Company's personal systems and printing businesses. *See* http://investors.hpe.com/faq; http://www8.hp.com/us/en/hpe/hp-information/about-hp/history/hp-timeline/timeline.html (2014 "HP to Split").

344. HPE sells a wide variety of unmanaged, smart managed, and fully managed switches, including Fast Ethernet and Gigabit Ethernet switches, under both the HPE name and the Aruba name. *See* https://www.hpe.com/us/en/networking/switches.html. Aruba switches are based on the formerly HP-branded "ProVision" and "ProCurve" switches. *See* http://www8.hp.com/us/en/products/networking-switches/product-detail.html?oid=1008605435 (describing the Aruba 3810 Switch Series as based on the ProVision ASIC); *see also* http://www.hp.com/rnd/itmgrnews/built_for_future.htm (explaining that the HP ProCurve 5400/3500 Series switches are based on the ProVision

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ASIC).

345. I understand that HPE produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to HPE and Aruba networking products. I also understand that a HPE representative executed a sworn declaration attesting that the documents produced by HPE under the subpoena are authentic copies of documents created in the ordinary course of business.

346. I have analyzed HPE product manuals for several of its networking products for purposes of this Report. Those product manuals include:

i) "HP ProCurve Command Line Interface Reference … HP ProCurve Routing Switches 9304m, 9308m, and 9315m" (May 2002) [HPE92708], *available at* ftp.hp.com/pub/networking/software/59903044.pdf

ii) "SROS Command Line Interface Reference Guide Software Version J.02.01 or Greater" (for ProCurve Secure Router products) (Jan. 2005) [HPE93160], *available at* ftp.hp.com/pub/networking/software/SROS-Command-Line-Interface-Reference-Guide.pdf

iii) "ProCurve Switches K.12.XX Command Line Interface Reference Guide" (Jan. 2007) [HPE03126]

iv) "ProCurve Switches K.13.XX Command Line Interface Reference Guide" (Mar. 2008) [HPE04995]

v) "HP ProCurve Switch Software Command Line Interface Reference Guide" (Apr. 2009) [HPE10303]

vi) "HP Switch Software Access Security Guide K/KA.15.13" (Jun. 2013) [HPE43019]

vii) "HP Switch Software Advanced Traffic Management Guide K/KA.15.13" (June 2013) [HPE44032]

viii) "HP Switch Software Basic Operation Guide" (Jun. 2013) [HPE44508]

ix) "HP Switch Software IPv6 Configuration Guide K/KA.15.14" (Oct. 2013) [HPE45955]

x) "HP Switch Software Management and Configuration Guide K/KA.15.14" (Oct. 2013) [HPE46789]

xi) "HP Switch Software Multicast and Routing Guide K/KA.15.14" (Oct. 2013) [HPE48032]

xii) "HP Networking and Cisco CLI Reference Guide" (Nov. 2015) [HPE49320]

xiii) "HP Networking and Cisco CLI Reference Guide" (Mar. 2010) [HPE48996]

I also considered: ARISTANDCA13270722, as well as the publicly available HP command reference manual available for download on HP's corporate website at the following address: ftp://ftp.hp.com/pub/networking/software/9408sl-9300m-CLI-Jun2005-59906031.pdf (ARISTANDCA00287991).

347. Based on my review of HPE materials, it is my opinion that HPE networking products support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at

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issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

348. HPE networking products supported substantially the same four command modes that are disputed in this litigation as early as 2002, with substantially the same prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by the HPE CLI as of 2002 is shown below:

Cisco Command Mode	Cisco Command Prompt[84]	HP ProCurve CLI Command Mode	HP ProCurve CLI Command Prompt
User EXEC	router> switch>	User EXEC	HP9300>
Privileged EXEC	router# switch#	Privileged Exec	HP9300#pending
Global Configuration	router(config)# switch(config)#	CONFIG ("global CONFIG" level)	HP9300(config)#
Interface Configuration	router(config-if)# switch(config-if)#	CONFIG ("interface level")	HP9300(config-if-5/1)#[85]

[HPE92708 at Pages 2-1 to 2-6] (May 2002 ProCurve CLI Reference).

349. As the 2002 ProCurve manual explains: "User EXEC – Lets you display information and perform basic tasks such as pings and trace routes. … Privileged EXEC – Lets you use the same commands as those at the User EXEC level plus configuration

[84] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.
[85] The "5/1" portion of the Interface CONFIG prompt indicates the particular port that is being configured. *See* [HPE92708 at Page 2-6] (May 2002 ProCurve CLI Reference). It could also be, for example, HP9300(config-if-1/1)# if port 1/1 is being configured. *Id.* at Page 6-4.

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commands that do not require saving the changes to the system-config file." [HPE92708 at Page 2-1] (May 2002 ProCurve CLI Reference). The same manual further explains, "CONFIG commands modify the configuration of an HP Routing Switch. … The global CONFIG level allows you to globally apply or modify parameters for ports on the device. … The interface [CONFIG] level allows you to assign or modify specific port parameters on a port-by-port basis." [HPE92708 at Pages 2-2 and 2-3] (May 2002 ProCurve CLI Reference).

350. In more recent ProCurve devices, the four HPE command modes described above functioned in substantially the same way with substantially the same prompts. *See, e.g.*, [HPE44508 at Pages 26-31] (June 2013 HPE Switch Software Basic Operation Guide) (calling the "User EXEC" mode "Operator" mode, and "Privileged EXEC " mode "Manager" mode, but retaining the same prompts and functionality, and calling the "Interface Configuration" mode "Context Configuration" with a slightly different prompt); [HPE03126 at Pages 13, 138] (Jan. 2008 ProCurve CLI Guide) (describing "Operator" and "Manager" command modes, but and "Global Configuration" and "Interface Configuration" command modes); [HPE49320 at Page 12] (Nov. 2015 HP/Cisco CLI Guide) (showing HP ProVision and Cisco having the same command modes and prompts).

351. The HPE CLIs also supported several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key. *See* [HPE92708 at Pages 2-1, 2-7] (May 2002 ProCurve CLI Reference); [HPE49320 at Page 10] (Nov. 2015

HP/Cisco CLI Guide).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [HPE92708 at Pages 2-1, 2-7] (May 2002 ProCurve CLI Reference); [HPE44508 at Pages 31-33] (June 2013 HPE Switch Software Basic Operation Guide); [HPE49320 at Page 10] (Nov. 2015 HP/Cisco CLI Guide).

iii) A "syntax shortcuts" feature, which means: "A command or parameter can be abbreviated as long as enough text is entered to distinguish it from other commands at that level. For example, given the possible commands copy tftp… and config tftp…, possible shortcuts are cop tftp and con tftp respectively. In this case, co does not properly distinguish the two commands." *See* [HPE92708 at Page 2-12] (May 2002 ProCurve CLI Reference).

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See* [HPE92708 at Page 6-66] (May 2002 ProCurve CLI Reference).

352. Substantial similarities between CLI functionality of PE ProVision/ProCurve, and Cisco, including modes, prompts, and commands, are also shown in several HPE documents created specifically to highlight the substantial similarities between both CLIs. *See*, *e.g.*, [HPE49320] (Nov. 2015 HP/Cisco CLI Guide) (showing, in a 500-plus page reference manual, a direct comparison between the HP ProVision/ProCurve CLI and Cisco IOS CLI, including many of the exact same commands, modes, and prompts).

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353. HPE also sold a different, non-ProVision/ProCurve line of switches and routers that used a different operating system called Comware. *See, e.g.*, [HPE49320] (Nov. 2015 HP/Cisco CLI Guide) (including the Comware CLI in the comparison of the ProVision/ProCurve and Cisco IOS CLI). The Comware CLI is substantially similar in many respects to the Huawei CLI (as the Huawei CLI existed as of 2010); for example, the command prompts are the same, both the Comware and Huawei CLI use "display" instead of "show" for well-known "show" CLI commands, both Huawei and Comware use "undo" instead of "no" to negate CLI commands, both Huawei and Comware use "reset" instead of "clear" for well-known "clear" CLI commands, both Huawei and Comware use "debugging" instead of "debug" for well-known "debug" CLI commands, and both Huawei and Comware use "peer" instead of "neighbor" to in their CLI commands. *See id.*; *see also* CSI-CLI-02112421 (2010 Huawei vs. Cisco CLI Comparison Guide). Further examples of substantial similarities between the Comware and Huawei CLI can be seen by reviewing the above cited manuals.

354. I understand that HP purchased 3Com Corporation in April 2010. *See* http://www8.hp.com/us/en/hp-news/press-release.html?id=342187#.V0D26oQrJD8 ("HP Completes Acquisition of 3Com Corporation, Accelerates Converged Infrastructure Strategy"). With that acquisition, HP "integrate[d] 3Com's network switching, routing and security solutions with its existing HP ProCurve solutions[.]" *Id.* The Comware operating system came from the 3Com and H3C switches. *See* [HPE48996 at Page 7] (Mar. 2010 HP Networking and Cisco CLI Reference Guide) ("Comware 5 runs on H3C and 3Com switches, which are now part of the HP Networking portfolio."); [HPE49320 at Page 544] (Nov. 2015 HP/Cisco CLI Guide) (explaining Comware's origins in 3Com

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and H3C products).

355. I understand that the similarities between the Comware CLI, which came from 3Com, and the Huawei CLI stem from a 2004 agreement to settle a lawsuit filed by Cisco against Huawei and 3Com. *See* [CSI-CLI-02555741] (Cisco CLI Report for Cisco v. Huawei/3Com Lawsuit); [CSI-CLI-02555798] (Final Settlement Agreement Between Cisco, Huawei, and 3Com). I understand that 3Com intervened in the lawsuit between Cisco and Huawei because, according to 3Com's filings in the Huawei lawsuit, it had formed a joint venture company with Huawei (called H3C) and would be reselling Huawei's switching and routing products in the United States under the 3Com name. *See* [CSI-CLI-01481684] (3Com's briefing in the Huawei lawsuit explaining why it was joining the case).

356. For these reasons, the differences between the Comware CLI on the one hand, and the substantially similar ProCurve and Cisco IOS CLIs on the other hand, are attributable to the same reasons underlying the differences between the current Huawei CLI on the one hand, and the Cisco IOS CLI and other industry-standard CLIs on the other hand. The differences stem from a negotiated settlement agreement between Cisco, Huawei, and 3Com to resolve litigation filed by Cisco against Huawei in 2003.

357. Despite the differences between the Comware CLI and the Cisco IOS CLI (as well as other industry standard CLIs), HPE switches support a feature called command aliasing that allows the user to configure the switch so that Cisco-like commands are supported on a Comware CLI. *See, e.g.*, [HPE70639 at Pages 1-10 to 1-11] (2009 3Com Comware Configuration Guide) ("Configuring Command Aliases … You can replace the first keyword of a command supported by the device with your

preferred keyword by configuring the command alias function. For example, if you configure show as the replacement of the display keyword for each display command, you can input the command alias show xx to execute the display xx command."); [HPE48627 at Pages 1-2] (May 2012 HP 10500 Switch Command Reference) (describing the "command-alias mapping" CLI command).

358. [86]Indeed, the HPE CLI manuals provide an explicit example of using the command aliasing functionality, and the Comware "command-alias mapping" command to transform a "display clock" CLI command into a "show clock" CLI command:

Examples

Define **show** as the alias of the **display** keyword.

```
<Sysname> system-view
[Sysname] command-alias mapping display show
```

After you configure the alias, you can enter **show** to execute a **display** command. For example, you can enter **show clock** to execute the **display clock** command.

[HPE48627 at Pages 1-2] (May 2012 HP 10500 Switch Command Reference).

359. By using the command aliasing functionality on a Comware switch, the Comware CLI could be configured to allow the user to enter industry-standard "show" commands instead of "display" commands, use a "no" prefix instead of "undo" to negate a command per the industry-standard CLI, and enter industry standard "clear"commands instead of "reset" commands. Examples of using the "command-alias" CLI command to make the Comware CLI behave in an industry-standard manner is shown below:

- command-alias enable
- command-alias mapping quit exit

[86] This command aliasing feature is also found in ProCurve switches. *See* [HPE10303 at Page 63] (Apr. 2009 ProCurve CLI Manual) (discussing the "alias" command for CLI command aliasing); [HPE44508 Pages 41-43] (Sept. 2013 HP CLI Manual). As discussed elsewhere in this Report, both Cisco and Arista CLIs also support this command aliasing functionality.

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- command-alias mapping undo no
- command-alias mapping display show
- command-alias mapping reboot reload
- command-alias mapping header banner
- command-alias mapping reset clear
- command-alias mapping acl access-list
- command-alias mapping port switchport
- command-alias mapping stp spanning-tree
- command-alias mapping snmp-agent snmp-server
- command-alias mapping user-interface line
- command-alias mapping return end
- command-alias mapping sysname hostname
- command-alias mapping save write
- command-alias mapping delete erase
- command-alias mapping info-center logging

360. The HPE networking products I analyzed for this Report also support well over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the HPE networking equipment CLIs and Cisco CLIs is provided in **Appendix H.HP**. As shown in that detailed analysis, HPE has supported at least 128 of the same Cisco CLI commands that are disputed in this lawsuit.

361. My opinion that HPE's networking products relating to its ProCurve\Provision product line support an industry-standard CLI is supported by the

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sworn deposition testimony of HPE's own corporate witness, as well as its product materials. At the deposition of HPE's corporate witness, Mr. Venkatraman, the witness confirmed that HPE networking products followed and supported the industry-standard CLI. *See*, *e.g.*, HPE Corp. (Venkatraman) Dep. Tr. at 95-114. The HPE witness also confirmed that several HPE product materials mentioning an industry-standard CLI were describing the same industry-standard CLI he described earlier in his deposition testimony, which is the same industry-standard CLI I discussed in this Report. *See, e.g.*, HP Corp.(Venkatraman) Dep. Tr. at 95-114; Exhs. 639 to 644 [ARISTANDCA00224908, ARISTANDCA00224917, ARISTANDCA00225130, ARISTANDCA00224950, ARISTANDCA00225269, ARISTANDCA00224906]. Those HPE documents, and HPE's own testimony, add further support to my opinion that the HPE ProCurve CLI supports an industry-standard CLI.

12. Juniper Networks JUNOSe CLI

362. Founded in 1996, Juniper Networks sells a wide array of carrier-class, high-density switches for branch, campus and data center applications, as well as routers for enterprise and service provider networks. *See* http://www.juniper.net/us/en/company/profile/; http://www.juniper.net/us/en/company/profile/history/; http://www.juniper.net/us/en/products-services/switching/; http://www.juniper.net/us/en/products-services/routing/.

363. In May 2002, Juniper announced its acquisition of Unisphere Networks, Inc., a provider of carrier-class IP infrastructure products for data, voice and rich media services. *See* http://juniper.mwnewsroom.com/manual-releases/2002/Juniper-Networks-

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to-Acquire-Siemens-Unisphere-Netw; [Juniper (Kasten) Dep. Tr. at 9-10, 27-35, 50-53, 73-74]. The JUNOSe CLI for the Juniper E-Series routers came from the Unisphere acquisition and its products. *See* http://www.networkworld.com/article/2278150/data-center/cisco-s-ios-vs--juniper-s-junos.html; [Juniper (Kasten) Dep. Tr. at 9-10, 27-35, 50-53, 73-74].

364. I understand that Juniper produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to Juniper networking products. I also understand that a Juniper representative executed a sworn declaration attesting that the documents produced by Juniper under the subpoena are authentic copies of documents created in the ordinary course of business.

365. I also reviewed transcripts from the depositions taken of Juniper to prepare this Report, including the deposition of Juniper corporate witness Phil Kasten.

366. I have analyzed Juniper and Unisphere product manuals for several E-Series (including "ERX" branded) networking products for purposes of this Report. Those product manuals include:

i) "Unisphere ERX-700/1400 Edge Routing Switch Command Reference Guide Release 1.3.0" (Mar. 2000) [19008JNPR00144974].

ii) "Unisphere ERX-700/1400 Edge Routing Switch Configuration Guide, Vol. 1 ERX System, Physical Layer, Link Layer Release 1.3.0" (Mar. 2000) [19008JNPR00145307].

iii) "Juniper ERX Edge Routers Command Reference Guide Release 4.0.x" (Nov. 2002) [19008JNPR00145663].

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iv) "Juniper ERX Edge Routers System Basics Configuration Guide Release 4.0.x" (Nov. 2002) [19008JNPR00146233].

v) "E-Series Routers Command Reference Guide A to M Release 5.1.x" (Aug. 2003) [19006JNPR00124303]

vi) "E-Series Routers Command Reference Guide N to Z Release 5.1.x" (Aug. 2003) [19006JNPR00124691]

vii) "JUNOSe Internet Software for E-series Routing Platforms Command Reference Guide A to M Release 7.1.x" (Nov. 2005) [19006JNPR00130657]

viii) "JUNOSe Internet Software for E-series Routing Platforms Command Reference Guide N to Z Release 7.1.x" (Nov. 2005) [19006JNPR00130175]

ix) "JunosE Software for E Series Broadband Services Routers Command Reference A to M Release 15.1.x" (Aug. 2014) [19006JNPR00121081]

x) "JunosE Software for E Series Broadband Services Routers Command Reference N to Z Release 15.1.x" (Aug. 2014) [19006JNPR00122695]

xi) "JunosE Software for E Series Broadband Services Routers System Basics Configuration Guide Release 15.1.x" (Aug. 2014) [19008JNPR00144310].

367. Based on my review of Juniper E-Series materials, including materials for Juniper devices that support the JUNOSe CLI, it is my opinion that Juniper E-Series

networking products support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

368. Juniper E-Series networking products supported substantially the same four command modes that are disputed in this litigation as early as 2002, and Unisphere (prior to being acquired by Juniper) supported the same four command modes as early as 2000, with substantially the same prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by the Juniper JUNOSe (as of 2002) and Unisphere CLIs (as of 2000) is shown below:

Cisco Command Mode	Cisco Command Prompt[87]	Unisphere CLI Command Mode	Unisphere CLI Command Prompt
User EXEC	router> switch>	User EXEC	ERX-0-1-90>
Privileged EXEC	router# switch#	Privileged Exec	ERX-0-1-90#
Global Configuration	router(config)# switch(config)#	Global Configuration	ERX-0-1-90(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	ERX-0-1-90(config-if)#

[19008JNPR00145307 at Pages 1-1 to 1-22] (Mar. 2000 Unisphere ERX-700/1400 Edge Routing Switch Config. Guide) (discussing all command modes and prompts).

[87] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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Cisco Command Mode	**Cisco Command Prompt**[88]	**JUNOSe CLI Command Mode**	**JUNOSe CLI Command Prompt**
User EXEC	router> switch>	User EXEC	host1>
Privileged EXEC	router# switch#	Privileged EXEC	host1#
Global Configuration	router(config)# switch(config)#	Global Configuration	host1(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	host1(config-if)#

[19008JNPR00146233 at Pages 2-1 to 2-54] (Nov. 2002 Juniper ERX System Basics Config. Guide) (discussing all command modes and prompts); *see also, e.g.*, [19006JNPR00124303 at Pages 46, 86, 111, and 119] (Aug. 2003 Juniper E-Series Routers CLI Guide A to M) (showing the same four command modes supported in the JUNOSe CLI); [19006JNPR00121081 at Pages xxxviii, 25, 170, 281] (Aug. 2014 JUNOSe CLI Guide A toM) (showing the same four command modes supported in the JUNOSe CLI, and associated prompts); [19008JNPR00144310 at Pages 67-117] (Aug. 2014 JUNOSe System Basics Config. Guide) (discussing all command modes and prompts and supporting the same command modes and prompts as shown above).

369. Indeed, the March 2000 Unisphere Configuration Guide (Vol. 1) provides a helpful overview of the command mode architecture that is common across many vendor switches and routers, including the disputed Cisco IOS and Arista EOS products in this litigation, as discussed in this Report. The command mode architecture in the March 2000 Unisphere Configuration Guide also appears in substantially the same form

[88] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

(but with more sub-configuration modes) in recent Juniper E-Series manuals as part of the documentation discussion of the "industry de facto standard CLI." The command mode architecture diagram from the March 2000 Unisphere Configuration Guide is shown below, and in my opinion provides a clear overview of the industry standard command mode architecture used by most vendors in the networking industry that I have analyzed in this Report:

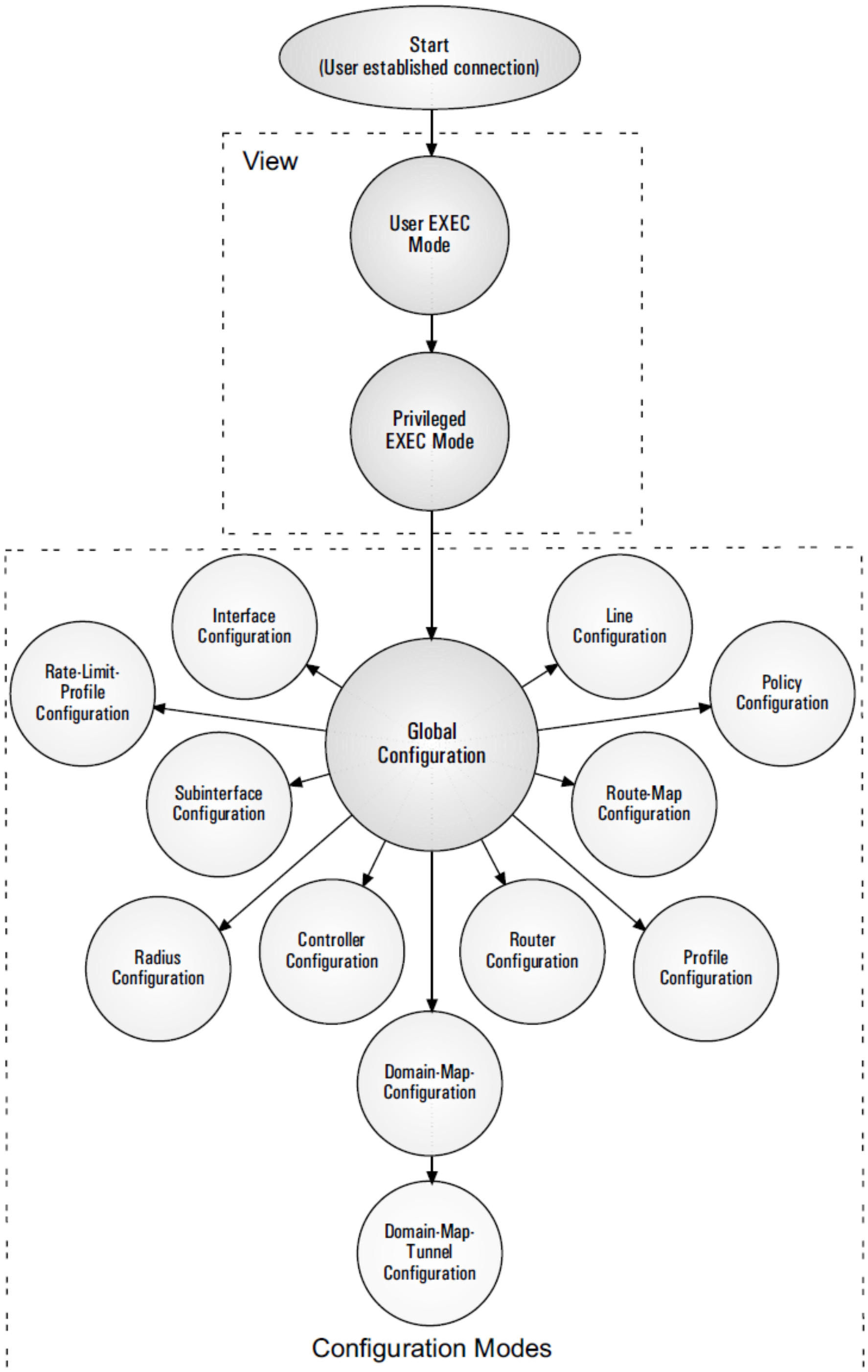

Figure 1-1 Command Mode Architecture

See [19008JNPR00145307 at Page 1-2, Fig. 1-1] (Mar. 2000 Unisphere ERX-700 Config. Guide).

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370. As the August 2014 Juniper JUNOSe System Basics Configuration Guide explains: "The CLI is the interface to the software that you use whenever you access the router—whether from the console or through a remote network connection. The CLI, which automatically starts after the router finishes booting, provides commands that you use to perform various tasks, including configuring the JunosE Software and monitoring and troubleshooting the software, network connectivity, and the router hardware. Managing your router using the CLI gives you access to thousands of commands. ***The router's CLI uses an industry de facto standard look and feel***, which might be familiar to you." [19008JNPR00144310 at Page 27] (Aug. 2014 JUNOSe System Basics Config. Guide) (emphasis added).

371. Indeed, Juniper began describing the JUNOSe CLI in its user documentation as using "an industry de facto standard look and feel" in the E-Series routers since as early as 2002—nearly 14 years ago. *See* [19008JNPR00146233 at Page 2-1] (Nov. 2002 Juniper ERX System Basics Config. Guide) ("Managing your system using the CLI gives you access to thousands of commands. ***The system's CLI uses an industry de facto standard look and feel***, which may be familiar to you.") (emphasis added).

372. In my opinion, the Juniper documentation over the past 14 years is correct in describing the Juniper JUNOSe E-Series CLI as using a de facto industry standard CLI, as shown in and supported by my analysis of multiple vendors' CLIs, including the disputed Cisco IOS and Arista EOS CLIs, in this Report.

373. The JUNOSe E-Series and Unisphere CLIs also supported several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI.

This includes:

i) Command completion functionality, triggered when hitting the "Tab" key. *See* [19008JNPR00145307 at Page 1-11] (Mar. 2000 Unisphere ERX-700 Config. Guide); [19008JNPR00144310 at Page 32] (Aug. 2014 Juniper JUNOSe Config. Guide).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [19008JNPR00145307 at Page 1-11] (Mar. 2000 Unisphere ERX-700 Config. Guide); [19008JNPR00144310 at Page 61] (Aug. 2014 Juniper JUNOSe Config. Guide).

iii) An "abbreviated commands" feature, which means: "You can abbreviate keywords to save time, as long as you enter at least enough leading characters to uniquely identify the desired keyword." *See* [19008JNPR00145307 at Pages 1-10 to 1-11] (Mar. 2000 Unisphere ERX-700 Config. Guide); [19008JNPR00144310 at Page 31] (Aug. 2014 Juniper JUNOSe Config. Guide).

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See* [19008JNPR00145307 at Page 1-3] (Mar. 2000 Unisphere ERX-700 Config. Guide); [19008JNPR00144310 at Pages 32-33] (Aug. 2014 Juniper JUNOSe Config. Guide).

374. The Juniper JUNOSe-based networking products I analyzed for this Report also support hundreds of industry-standard CLI commands and command

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hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Juniper JUNOSe-based networking equipment CLIs and Cisco CLIs is provided in **Appendix H.JE**. As shown in that detailed analysis, Juniper has supported at least 218—or close to half—of the same Cisco CLI commands that are disputed in this lawsuit.

375. My opinion that Juniper's E-Series products support an industry-standard CLI is supported by the sworn deposition testimony of Juniper's own corporate witness, as well as its product materials. As discussed above, Juniper's corporate witness, Mr. Kasten, confirmed at his deposition that the JUNOSe CLI—which was based on the Unisphere CLI—supported "industry typical, industry common commands to represent the operations that we were trying to do." Juniper Corp. Dep. Tr. (Kasten) at 25-26 ("So we relied on what we considered industry practices for those commands so that if you commanded a system, commanded a system to do something, the outcome of that system would match your expectation."); *see also id.* at 33-34 (testifying that the JUNOSe CLI arise from "an intention of design so that the outcomes you would get when commanding a system would be what you expect them to be because there's this industry standard way to express those commands.").

376. Mr. Kasten also discussed the expectations of particular customers at his deposition: "**Q.** [D]o you have any memory of what customers might have said to you or you might have said to customers relating to the subject of the CLI being industry standard? … **THE WITNESS:** The only specific conversation that I do recall was when we were in alpha testing of our first Redstone product. And one of the commands that we did not include in our first version of software in this alpha stage was a command that

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they—this beta customer or alpha customer assumed would be there and asked how we could justify not having this command in place. In fact, it was—it was so much expected to be there, because it was a standard one, that it was the first command that he typed. And it wasn't there. … **Q.** Do you remember which command that was? **A.** Yes, I do. **Q.** What command was it? **A.** It was 'show config.' **Q.** And did you add that command to the CLI? **A.** Yes, we did." Juniper Corp. Dep. (Kasten) at 51-52.

377. Mr. Kasten also confirmed that command modes are just as part of the industry-standard CLI as the commands themselves: "**Q.** Are there certain command modes that are standard in the industry? … **THE WITNESS:** Command modes and the sets of commands in them, which is what a command mode is, and the commands that put you into those command modes were as much a part of the command line experience as the—as the specific commands. So in that sense, it was, I would say as industry standard as the rest of it." Juniper Corp. Dep. (Kasten) at 62. All of the cited testimony from Mr. Kaplan regarding the JUNOSe CLI, including his testimony regarding the industry-standard nature particular CLI commands supported by JUNOSe (*see, e.g.*, *id.* at 63-72), is consistent with my opinion regarding the industry-standard CLI, and its use by networking vendors, including Juniper.

378. And as discussed above, Juniper's documentation for the E-Series routers, since at least 2002, further emphasized that the JUNOSe CLI supported an industry *de facto* standard CLI. *See*, *e.g.*, [19008JNPR00144310 at Page 27] (Aug. 2014 JUNOSe System Basics Config. Guide) (emphasis added).

13. Lenovo, IBM, and BNT CLI ("ISCLI")

379. Lenovo sells a wide range of Ethernet networking products, including

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Layer 2, Layer 3, and converged top-of-rack Gigabit Ethernet switches. These Lenovo product offerings include its "RackSwitch" line of Ethernet switches, "Flex System" switching products, and "BladeCenter" switching products. *See, e.g.*, http://shop.lenovo.com/us/en/systems/networking/; http://shop.lenovo.com/us/en/systems/networking/ethernet-rackswitch/; http://shop.lenovo.com/us/en/systems/servers/blades/flex-system/networking/ethernet/switches/; http://shop.lenovo.com/us/en/systems/servers/blades/bladecenter/networking/ethernet/switches/.

380. Lenovo recently entered the Ethernet networking marketplace in 2015 after acquiring IBM's x86 server business. Prior to Lenovo's acquisition of IBM's switching business, IBM sold the "RackSwitch" and "Flex System" networking products. *See, e.g.*, https://www-03.ibm.com/press/us/en/pressrelease/44997.wss; http://news.lenovo.com/news-releases/lenovo-plans-to-acquire-ibms-x86-server-business.htm; http://news.lenovo.com/news-releases/lenovo-set-to-close-acquisition-ibms-x86-server-business.htm; http://blog.lenovo.com/en/blog/it-is-official-lenovo-networking-is-born. Many of IBM's Ethernet switching products came from IBM's acquisition of BLADE Network Technologies (BNT) in September 2010. At the time of its acquisition by IBM, BNT sold blade server and top-of-the-rack switches, including high-performance Ethernet switches. *See* http://www-03.ibm.com/press/us/en/pressrelease/32525.wss.

381. I understand that Lenovo produced documents in response to a document subpoena in this litigation, including product documentation and materials relating to

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Lenovo networking products. I also understand that a Lenovo representative executed a sworn declaration attesting that certain documents produced by Lenovo under the subpoena are authentic copies of documents created in the ordinary course of business.

382. I have also reviewed a sworn declaration from Mr. William T. Nelson, who is was employed by Nortel Networks, and then become one of the founders for Blade Network Technologies (BNT). *See* Declaration of William T. Nelson, Paragraphs 1 to 5. Mr. Nelson's declaration confirmed that the "Industry Standard CLI" or "ISCLI" came from a renaming of the Nortel Networks CLI, or NNCLI, in around 2005, and that the name "Industry Standard CLI" was chosen because the type of CLI (an industry-standard CLI as described in this Report, which would be familiar to users of CLIs from Cisco and Extreme Networks) "had become accepted within the industry and familiar to engineers likely to be using Blade switches." *Id.* Mr. Nelson's sworn statement regarding the ISCLI is consistent with, and supports, my opinions regarding the industry standard CLI in this Report.

383. I have analyzed Lenovo, IBM, and BNT product manuals for several of their networking products for purposes of this Report, some of which are still available for download directly from the technical and product support section of IBM's website. Those product manuals include:

i) "BNT BLADEOS 6.5 ISCLI–Industry Standard CLI Command Reference RackSwitch G8000" (Sept. 2010) [LENOVO-ARISTA012600], *available at* https://www-304.ibm.com/support/docview.wss?uid=isg3T7000381 (IBM product documentation web page for this particular switch);

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https://www-304.ibm.com/support/docview.wss?uid=isg3T7000381&aid=1 (direct download link).

ii) "IBM Networking OS 6.8 Industry Standard CLI Command Reference for the RackSwitch G8000" (Aug. 2012) [LENOVO-ARISTA013095], *available at* http://www-01.ibm.com/support/docview.wss?uid=isg3T7000555 (IBM product documentation web page for this particular switch); http://www-01.ibm.com/support/docview.wss?uid=isg3T7000555&aid=1 (direct download link).

iii) "IBM Flex System Fabric CN4093 10Gb Converged Scalable Switch ISCLI—Industry Standard CLI Command Reference for IBM Networking OS 7.7" (Aug. 2013) [LENOVO-ARISTA000001], *available at* http://pic.dhe.ibm.com/infocenter/flexsys/information/index.jsp?topic=%2Fcom.lenovo.acc.cn4093.doc%2FIO_Module_CN4093.html (IBM product documentation web page for this particular switch); http://pic.dhe.ibm.com/infocenter/flexsys/information/topic/com.lenovo.acc.cn4093.doc/00ay508.pdf (direct download link).

iv) "Lenovo RackSwitch G8264CS ISCLI—Industry Standard CLI Command Reference For Networking OS 8.2" (Apr. 2015)

[LENOVO-ARISTA005263], *available at* http://publib.boulder.ibm.com/infocenter/systemx/documentation/topic/com.lenovo.rackswitch.g8264cs.doc/G8264CS_CR_8-2.pdf (direct download link).

v) "Lenovo Flex System CN4093 10Gb Converged Scalable Switch ISCLI—Industry Standard CLI Command Reference For Networking OS 8.2" (Apr. 2015) [LENOVO-ARISTA002221], *available at* http://pic.dhe.ibm.com/infocenter/flexsys/information/topic/com.lenovo.acc.cn4093.doc/CN4093_CR_8-2.pdf (direct download link).

vi) "Lenovo RackSwitch G8264CS ISCLI—Industry Standard CLI Command Reference for Networking OS 8.3" (Aug. 2015) [LENOVO-ARISTA005923], *available at* http://publib.boulder.ibm.com/infocenter/systemx/documentation/topic/com.lenovo.rackswitch.g8264.doc/G8264_CR_8-3.pdf (direct download link).

vii) "Lenovo Flex System CN4093 10Gb Converged Scalable Switch ISCLI—Industry Standard CLI Command Reference For Networking OS 8.3" (Oct. 2015) [LENOVO-ARISTA002873], *available at* http://pic.dhe.ibm.com/infocenter/flexsys/information/topic/com.lenovo.acc.cn4093.doc/CN4093_CR_8-3.pdf (direct download link)

I also considered: ARISTANDCA13273536, ARISTANDCA13276058,

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ARISTANDCA13273702.

384. Based on my review of Lenovo, IBM, and BNT materials, and in particular documentation for Lenovo, IBM, and BNT switching products that support what those entities called the "Industry Standard CLI" or "ISCLI," it is my opinion that Lenovo, IBM, and BNT networking products support (or supported) an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

385. Networking products featuring ISCLI supported substantially the same four command modes that are disputed in this litigation as early as 2010 (in BNT switches), with substantially the same prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by ISCLI is shown below:

Cisco Command Mode	Cisco Command Prompt[89]	ISCLI Command Mode	ISCLI Command Prompt
User EXEC	router> switch>	User EXEC	G8000>
Privileged EXEC	router# switch#	Privileged Exec	G8000#
Global Configuration	router(config)# switch(config)#	Global Configuration	G8000(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Port Configuration	G8000(config-if)#

[89] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

[LENOVO-ARISTA012600 at Pages 20-22] (Sept. 2010 BNT RackSwitch ISCLI Manual). The same command modes and prompts remained supported by IBM ISCLI switches after IBM acquired BNT. [LENOVO-ARISTA013095 at Pages 1-2] (Aug. 2012 IBM RackSwitch ISCLI Manual). The same command modes and prompts are still supported by Lenovo ISCLI switches as of August 2015. [LENOVO-ARISTA005923 at Pages 22-23] (Aug.2015 Lenovo RackSwitch ISCLI Manual).

386. As the 2010 BNT manual described, these four command modes (and associated prompts) provided substantiality the same functionality as the disputed command modes and prompts in the Cisco IOS CLI and Arista EOS CLI: "The ISCLI has three major command modes listed in order of increasing privileges, as follows: … □ User EXEC mode … This is the initial mode of access. … Privileged EXEC mode … This mode is accessed from User EXEC mode. This mode can be accessed using the following command: enable … Global Configuration mode … This mode allows you to make changes to the running configuration. … Several sub-modes [such as Interface Port Configuration mode] can be accessed from the Global Configuration mode. … Each mode provides a specific set of commands. The command set of a higher-privilege mode is a superset of a lower-privilege mode—all lower-privilege mode commands are accessible when using a higher-privilege mode." [LENOVO-ARISTA012600 at Pages 20-22] (Sept. 2010 BNT RackSwitch ISCLI Manual); *see also* [LENOVO-ARISTA013095 at Pages 1-2] (Aug. 2012 IBM RackSwitch ISCLI Manual) (providing the same functional description); [LENOVO-ARISTA005923 at Pages 22-23] (Aug. 2015 Lenovo RackSwitch ISCLI Manual) (same).

387. The ISCLI-based networking products from BNT, IBM, and Lenovo also

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supported several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key (also called "Tab Completion"). *See* [LENOVO-ARISTA012600 at Page 26] (Sept. 2010 BNT RackSwitch ISCLI Manual); [LENOVO-ARISTA013095 at Page 7] (Aug. 2012 IBM RackSwitch ISCLI Manual); [LENOVO-ARISTA005923 at Page 29] (Aug.2015 Lenovo RackSwitch ISCLI Manual).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [LENOVO-ARISTA012600 at Page 23] (Sept. 2010 BNT RackSwitch ISCLI Manual); [LENOVO-ARISTA013095 at Page 4] (Aug. 2012 IBM RackSwitch ISCLI Manual); [LENOVO-ARISTA005923 at Page 26] (Aug. 2015 Lenovo RackSwitch ISCLI Manual).

iii) A "command abbreviation" feature, which means: "Most commands can be abbreviated by entering the first characters which distinguish the command from the others in the same mode." *See* [LENOVO-ARISTA012600 at Page 25] (Sept. 2010 BNT RackSwitch ISCLI Manual); [LENOVO-ARISTA013095 at Page 6] (Aug. 2012 IBM RackSwitch ISCLI Manual); [LENOVO-ARISTA005923 at Page 29] (Aug.2015 Lenovo RackSwitch ISCLI Manual).

iv) Use of a "no" keyword before a CLI command to negate the effect

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of the command. *See* [LENOVO-ARISTA012600 at Pages 211-212] (Sept. 2010 BNT RackSwitch ISCLI Manual) (showing examples of "[no]" keyword for specific commands); [LENOVO-ARISTA013095 at Pages 183-184] (Aug. 2012 IBM RackSwitch ISCLI Manual) (same); [LENOVO-ARISTA005923 at Pages 295-296] (Aug.2015 Lenovo RackSwitch ISCLI Manual) (same).

388. The ISCLI-based networking products I analyzed for this Report also support over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the ISCLI-based networking equipment CLIs and Cisco CLIs is provided in **Appendix H.ISCLI**. As shown in that detailed analysis, Lenovo, IBM, and BNT networking devices that supported ISCLI also supported at least 106 of the same Cisco CLI commands that are disputed in this lawsuit.

14. Netgear CLI

389. NETGEAR sells, among other products, high-speed fully managed 10 Gigabit Ethernet switches for enterprise and campus applications, including its ProSAFE line of Ethernet switches. *See* http://www.netgear.com/landing/10gigabit.aspx?cid=gwmng.

390. I have analyzed the following NETGEAR product manuals, which are available to download directly from the product documentation section of NETGEAR's corporate website, for purposes of this Report:

i) "NETGEAR ProSafe Managed Switch Command Line Interface (CLI) User Manual" (Oct. 2012) [ARISTANDCA13350585],

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available at http://www.downloads.netgear.com/docs/m4100/enu/202-11161-01/cli.pdf (NETGEAR Website Technical Documentation).

ii) "NETGEAR M5300, M6100, and M7100 Series ProSAFE Managed Switches CLI Command Reference Manual" (Apr. 2015) [ARISTANDCA00279773], *available at* http://www.downloads.netgear.com/files/GDC/M5300/M5300-M6100-M7100_CLI_v11_20Apr2015.pdf (NETGEAR Website Technical Documentation).

391. Based on my review of NETGEAR materials relatings to its ProSAFE Managed Switch products, it is my opinion that NETGEAR networking products support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

392. NETGEAR's ProSAFE Managed Switch products supported substantially the same four command modes that are disputed in this litigation as early as 2012, with substantially the same prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by NETGEAR ProSAFE products is shown below:

Cisco Command Mode	Cisco Command Prompt[90]	NETGEAR ProSAFE	NETGEAR ProSAFE Command Prompt

[90] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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		Command Mode	
User EXEC	router> switch>	User EXEC	Switch>
Privileged EXEC	router# switch#	Privileged Exec	Switch#
Global Configuration	router(config)# switch(config)#	Global Config	Switch (Config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Config	Switch (Interface <unit/slot/port>)#[91]

[ARISTANDCA13350585 at Pages 12-15] (Oct. 2012 NETGEAR ProSAFE CLI Manual); [ARISTANDCA00279773 at Pages 17-22] (Apr. 2015 NETGEAR ProSAFE CLI Manual).

393. These command modes and prompts in the NETGEAR ProSAFE CLI provide substantially the same functionality as the accused Arista EOS CLI command modes and prompts in dispute in this litigation. [ARISTANDCA13350585 at Pages 12-15] (Oct. 2012 NETGEAR ProSAFE CLI Manual); [ARISTANDCA00279773 at Pages 17-22] (Apr. 2015 NETGEAR ProSAFE CLI Manual).

394. The NETGEAR ProSAFE networking products also support several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key (also called "Tab Completion"). *See*

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[91] The NETGEAR CLI supports several different "Interface Config" command prompts depending on the interface being configured. *See* [ARISTANDCA13350585 at Pages 12-15] (Oct. 2012 NETGEAR ProSAFE CLI Manual). This is similar to the various "Interface Configuration" modes supported by the Arista EOS CLI, where the prompt will be different depending on the interface being configured (*e.g.*, Ethernet, VLAN, or Port-Channel interfaces).

[ARISTANDCA13350585 at Pages 15-16] (Oct. 2012 NETGEAR ProSAFE CLI Manual); [ARISTANDCA00279773 at Page 22] (Apr. 2015 NETGEAR ProSAFE CLI Manual).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [ARISTANDCA13350585 at Pages 17-18] (Oct. 2012 NETGEAR ProSAFE CLI Manual); [ARISTANDCA00279773 at Page 24] (Apr. 2015 NETGEAR ProSAFE CLI Manual).

iii) A "command abbreviation" feature, which means: "Command abbreviation allows you to execute a command when you have entered there are enough letters to uniquely identify the command. You must enter all of the required keywords and parameters before you enter the command." *See* [ARISTANDCA13350585 at Pages 15-16] (Oct. 2012 NETGEAR ProSAFE CLI Manual); [ARISTANDCA00279773 at Page 22] (Apr. 2015 NETGEAR ProSAFE CLI Manual).

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See* [ARISTANDCA13350585 at Pages 11-12] (Oct. 2012 NETGEAR ProSAFE CLI Manual); [ARISTANDCA00279773 at Page 14] (Apr. 2015 NETGEAR ProSAFE CLI Manual).

395. The NETGEAR ProSAFE networking products I analyzed for this Report also support hundreds of industry-standard CLI commands and command hierarchies that

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are also supported by Cisco CLIs. A detailed analysis of the overlap between the NETGEAR ProSAFE networking equipment CLIs and Cisco CLIs is provided in **Appendix H.NG**. As shown in that detailed analysis, NETGEAR has supported at least 169 of the same Cisco CLI commands that are disputed in this lawsuit.

15. NextHop Technologies CLI

396. NextHop Technologies was a company that developed routing protocol software that it licensed to networking equipment vendors. *See* Adam Sweeney Dep. Tr. (Jan. 29, 2016) at 117-119 (discussing NextHop Technologies, the origin of NextHop manuals in Arista's possession and produced in this litigation). I understand that certain of NextHop's assets, including routing software and the documentation for that software, were acquired by Arista after NextHop went out of business. *Id.*; *see also id.* at 144.

397. [redacted]

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[redacted]

398. I analyzed forty-seven NextHop documents, which I understand were in the possession of Arista following its acquisition of NextHop assets relating to NextHop's routing software, for purposes of this Report. The forty-seven NextHop documents appear on their face to comprise the "GateD® NGC 2.9 Command Line Interface Manual" and are Bates numbered ARISTANDCA13352142 to ARISTANDCA13356565. The manual is split up into different chapters for different routing protocols and functionality, including many of the same protocols and functionality at issue in this case. *See, e.g.*, ARISTANDCA13352468 (Dec. 2006 NextHop GateD NGC 2.9 CLI Manual).

399. Several chapters of the NextHop CLI manual were produced as standalone document, and bear the date of March 5, 2007 on their face. *See* ARISTANDCA13352244 (Ch. 11 BGP); ARISTANDCA13354860 (Ch. 13 IS-IS); ARISTANDCA13355428 (Ch. 15 OSPF version 3); ARISTANDCA13355572 (Ch. 14 OSPF); ARISTANDCA13356192 (Ch. 18 RIP). The remaining NextHop documents bear the date of December 20, 2006 on their face.

400. Based on my review of NextHop materials relatings to its routing software products, it is my opinion that the NextHop routing software supported an industry standard CLI and had substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

401. The NextHop routing software CLI supported substantially the same four command modes that are disputed in this litigation as early as 2006, with substantially the same prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by the NextHop routing software is shown below:

Cisco Command Mode	**Cisco Command Prompt[92]**	**NextHop Command Mode**	**NextHop Command Prompt**
User EXEC	router> switch>	User Execution	routerz>
Privileged EXEC	router# switch#	Privileged Execution	routerz#
Global Configuration	router(config)# switch(config)#	Global Configuration	routerz(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Configuration	routerz(config-if)#

[ARISTANDCA13352468 at Pages 13-15] (Dec. 2006 NextHop GateD CLI Manual).

402. These command modes and prompts in the NextHop routing software CLI provide substantially the same functionality as the accused Arista EOS CLI command modes and prompts in dispute in this litigation. [ARISTANDCA13352468 at Pages 13-15] (Dec. 2006 NextHop GateD CLI Manual).

403. The NextHop routing software also supported several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key. *See* [ARISTANDCA13352468 at Pages 9-10] (Dec.

[92] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.

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2006 NextHop GateD CLI Manual).

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [ARISTANDCA13352468 at Page 11] (Dec. 2006 NextHop GateD CLI Manual).

iii) A "command abbreviation" feature, which means: "Valid commands are not required to be composed of complete tokens. Only a token's smallest unique abbreviation is required." *See* [ARISTANDCA13352468 at Page 10] (Dec. 2006 NextHop GateD CLI Manual).

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See*, *e.g.*, [ARISTANDCA13352468 at Pages 34, 36, and 39] (Dec. 2006 NextHop GateD CLI Manual) (showing examples of "no" versions of several commands).

404. The NextHop routing software I analyzed for this Report also supported well over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the NextHop routing software CLI and Cisco CLIs is provided in **Appendix H.NX**. As shown in that detailed analysis, NextHop has supported at least 123 of the same Cisco CLI commands that are disputed in this lawsuit.

16. Oracle and Sun Microsystems CLI

405. Oracle sells, among other products, Ethernet networking products for enterprise applications, including high-performance Layer 2 and Layer 3 top-of-rack Gigabit Ethernet Switches. *See*, *e.g.*,

http://www.oracle.com/us/products/networking/overview/index.html; http://www.oracle.com/us/products/networking/ethernet/switch-es1-24/overview/index.html; https://www.oracle.com/networking/switch-es2-64/index.html; https://www.oracle.com/networking/switch-es2-72/index.html. Oracle acquired Sun Microsystems in 2010. *See* http://www.oracle.com/us/corporate/press/018363; https://www.oracle.com/sun/index.html.

406. I have analyzed the following Oracle and Sun product manuals, which are available to download directly from the product documentation section of Oracle's corporate website, for purposes of this Report:

i) "Sun Netra CP3140 Switch Software Reference Manual" (Jan. 2010) [ARISTANDCA13363036], *available at* https://docs.oracle.com/cd/E19217-01/819-3774-15/819-3774-15.pdf (Oracle Website Technical Documentation).

ii) "Oracle Sun Ethernet Fabric Operating System CLI Base Reference Manual" (Aug. 2012) [ARISTANDCA13363443], *available at* https://docs.oracle.com/cd/E19285-01/pdf/E26513.pdf (Oracle Website Technical Documentation).

407. Based on my review of Oracle and Sun materials relatings to their switching products, it is my opinion that Oracle and Sun networking products support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI commands, command hierarchies, command modes, and command prompts.

408. Oracle and Sun switching products supported substantially the same four command modes that are disputed in this litigation as early as 2012, with substantially the same prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by Oracle and Sun products is shown below:

Cisco Command Mode	Cisco Command Prompt[93]	Oracle/Sun Command Mode	Oracle/Sun Command Prompt
User EXEC	router> switch>	User Exec[94] User EXEC	Switch> SEFOS>
Privileged EXEC	router# switch#	Privileged Exec Privileged EXEC	Switch# SEFOS#
Global Configuration	router(config)# switch(config)#	Global Config Global Configuration	Switch (Config)# SEFOS(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface Config Interface Configuration	Switch (Interface "if number")# SEFOS(config-if)#

[ARISTANDCA13363036 at Pages 23-30] (Jan. 2010 Sun Netra CLI Manual); [ARISTANDCA13363443 at Pages xxxiv, and 1-1 to 1-5] (Aug. 2012 Oracle Sun CLI Manual).

409. These command modes and prompts in the Sun and Oracle CLIs provide

[93] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco's Response to Arista Interrogatory No. 2, Exh. C.
[94] The top command modes and prompts some from the 2010 Sun Netra CLI manual, while the bottom command modes and prompts are found in the 2012 Oracle Sun CLI manual. The Oracle Sun CLI command modes and prompts as of 2012 appear to be the same as the disputed Cisco and Arista CLI command modes and prompts at issue in this lawsuit.

substantially the same functionality as the accused Arista EOS CLI command modes and prompts in dispute in this litigation. [ARISTANDCA13363036 at Pages 23-30] (Jan. 2010 Sun Netra CLI Manual); [ARISTANDCA13363443 at Pages xxxiv, and 1-1 to 1-5] (Aug. 2012 Oracle Sun CLI Manual).

410. The August 2012 Oracle Sun Ethernet Fabric Operating System CLI Base Reference Manual aptly describes its CLI as follows: "SEFOS [the operating system on the device] provides a subset of CLI commands that adhere to the ***industry-standard CLI syntax***. When an industry-standard command is available, the SEFOS native CLI command is shown first, with the industry-standard command shown after a slash (/). … ***Use the industry-standard CLI command whenever it is available***." [ARISTANDCA13363443 at Pages 1-1 to 1-2] (Aug. 2012 Oracle Sun CLI Manual). In my opinion, the August 2012 Oracle Sun CLI Manual accurately describes the Oracle CLI as supporting industry-standard CLI commands and an industry-standard CLI, just like the disputed Cisco and Arista CLIs in this lawsuit. *See also* [ARISTANDCA13363036 at Page 7] (Jan. 2010 Sun Netra CLI Manual) (listing "Industry standard CLI" as a feature of the product).

411. The Oracle and Sun networking products also support several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key (also called "Tab Completion"). *See* [ARISTANDCA13363036 at Pages 10, 12] (Jan. 2010 Sun Netra CLI Manual)

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ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [ARISTANDCA13363036 at Page 32] (Jan. 2010 Sun Netra CLI Manual); [ARISTANDCA13363443 at Page 10-2] (Aug. 2012 Oracle Sun CLI Manual) (examples of commands using a "no" keyword to disable functionality).

iii) A "command abbreviation" feature, which means: "[W]hen you have typed enough letters of a command to uniquely identify the command word … [y]ou can execute the command by pressing the Enter key (command abbreviation)[.]" *See* [ARISTANDCA13363036 at Page 12] (Jan. 2010 Sun Netra CLI Manual)

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See* [ARISTANDCA13363036 at Pages 31-32] (Jan. 2010 Sun Netra CLI Manual); [ARISTANDCA13363443 at Pages 2-2 and 2-3] (Aug. 2012 Oracle Sun CLI Manual) (examples of commands using a "no" keyword to disable functionality).

412. The Oracle and Sun networking products I analyzed for this Report also support well over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Oracle and Sun networking equipment CLIs and Cisco CLIs is provided in **Appendix H.SU**. As shown in that detailed analysis, Oracle and Sun networking products have supported at least 120 of the same Cisco CLI commands that are disputed in this lawsuit.

17. Procket Networks CLI

413. Procket Networks was founded in 1999 by former Cisco employee Anthony Li and others, and was in the business of developing and selling high-end Gigabit IP-based routers to compete with Cisco and Juniper in the networking market. [Anthony Li Dep. Tr. at 61-69]. According to Mr. Li's deposition testimony in this lawsuit, Procket Networks was not successful in selling its router products, and its intellectual property and the majority of its assets were acquired by Cisco in 2004. [Anthony Li Dep. Tr. at 61-63].

414. According to Mr. Li's deposition testimony, the Procket Networks routers supported a CLI that was designed to be "as compatible with the Cisco CLI as possible to maximize customer adoption." [Anthony Li Dep. Tr. at 154]. While there were instances where customers "encouraged [Procket] to change … very specific commands that they wanted corrected," Mr. Li explained that Procket Networks tried to make its CLI "syntactically and semantically identical to what Cisco did" and therefore the company "attempted to replicate the syntax and semantics of the [Cisco] CLI completely at a functional level." [Anthony Li Dep. Tr. at 154-155]. This replication included command responses, as well as other CLI functionality including command-line completion, tab-completion, and "bug-for-bug" compatibility. [Anthony Li Dep. Tr. at 156-158].

415. In preparing this Report, I reviewed the transcript from the deposition of Mr. Li, as well as deposition exhibits used at Mr. Li's deposition. Those exhibits included product documentation for Procket Networks products, which Mr. Li discussed and recognized at his deposition, I also reviewed while preparing this Report. *See, e.g.*, Li Dep. Tr. 163-167, Exhs. 145 to 147 (Procket Networks PRO/8000 Series User

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Manuals).

416. I have analyzed the following Procket Networks product manuals for purposes of this Report:

i) "Procket Networks Software Introduction Control Plane, Data Plane, CLI Basics, Minimum Configurations, Policies, Route Redistribution … PRO/8000 Series" (Nov. 2003) [ARISTANDCA13356947]

ii) "Procket Networks IPv6 Routing Protocols IPv6 basics, IS-IS, OSPFv3, RIPng, BGP … PRO/8000 Series" (Nov. 2003) [ARISTANDCA13357095]

iii) "Procket Networks System Management and Operations Service Agent, Diagnostic Manager, TACACS+, RADIUS, SPR, LACP, SNMP, RP Redundancy … PRO/8000 Series" (Nov. 2003) [ARISTANDCA13357279]

iv) "Procket Networks System Management and Operations Service Agent, Diagnostic Manager, TACACS+, RADIUS, SPR, LACP, SNMP, RP Redundancy … PRO/8000 Series" (Nov. 2003) [ARISTANDCA13357887]

v) "Procket Networks Procket Style Guide for Technical Documentation ... PRO/8000 Series" (Mar. 2004) [ARISTANDCA13358495]

417. I note that the above collection of Procket Networks manuals is not complete. As former Cisco and Procket engineer Anthony Li testified at his deposition:

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> **Q.** Are there any other Procket Networks manuals in addition to the three that we just looked at: Exhibits 145, 146 and 147?
>
> **A.** Yes. There's several. We're missing at least the IPv4 routing protocols guide. I believe there was a command reference guide.
>
> **Q.** Do you have copies of any of the other command reference manuals that haven't been marked today as exhibits?
>
> **A.** No, I do not. I was asked to destroy all copies as part of the acquisition.
>
> **Q.** … When you say 'as part of the acquisition,' what do you mean? What do you mean by that?
>
> **A.** When Cisco acquired the intellectual property of Procket Networks, lawyers and managers on both sides directed everyone to destroy any intellectual property they had relating to Procket Networks.

Anthony Li Dep. Tr. at 166:7-25 (discussing several of the manuals listed above).

418. Based on my review of Procket Networks materials relatings to their switching products, it is my opinion that Procket Networks products support an industry standard CLI and have substantial similarities in features and functionality to Cisco CLIs (including the Cisco IOS CLI and other CLIs at issue in this litigation) and the Arista EOS CLI. These substantial similarities include a significant overlap of the same CLI

commands, command hierarchies, command modes, and command prompts.

419. Procket Networks switching products supported substantially the same four command modes that are disputed in this litigation at least as of 2003, with substantially the same prompts for each command mode. A comparison of disputed Cisco command modes and prompts, and the command modes and prompts supported by Procket Networks products is shown below:

Cisco Command Mode	Cisco Command Prompt[95]	Procket Command Mode	Procket Command Prompt
User EXEC	router> switch>	Operations command mode (Non-Privileged Domain)	Router>
Privileged EXEC	router# switch#	Operations command mode (Privileged domain)	Router#
Global Configuration	router(config)# switch(config)#	Configuration command mode	Router(config)#
Interface Configuration	router(config-if)# switch(config-if)#	Interface subcommand mode	Router(config-if)#

[ARISTANDCA13356947 at Pages 18-19] (Nov. 2003 Procket Networks CLI Basics Guide”).

420. These command modes and prompts in the Procket Networks CLIs provide substantially the same functionality as the accused Arista EOS CLI command modes and prompts in dispute in this litigation. [ARISTANDCA13356947 at Pages 18-

[95] The top command prompt is for Cisco IOS, IOS XE, and IOS XR. The bottom command prompt is for Cisco NX-OS. *See* Cisco’s Response to Arista Interrogatory No. 2, Exh. C.

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19] (Nov. 2003 Procket Networks CLI Basics Guide").

421. The Procket Networks products also support several common features that are also found in the disputed Cisco CLIs and Arista EOS CLI. This includes:

i) Command completion functionality, triggered when hitting the "Tab" key (also called "Tab Completion"). *See* [ARISTANDCA13356947 at Page 21] (Nov. 2003 Procket Networks CLI Basics Guide").

ii) A context-sensitive help system triggered by entering the "?" character into the CLI. *See* [ARISTANDCA13356947 at Page 22] (Nov. 2003 Procket Networks CLI Basics Guide").

iii) A "command abbreviation" feature, which means: "The CLI accepts abbreviated command syntax, which saves you time in configuring your router. This example shows the router accepting the config t and int g0/0/2 commands. The official syntax of these commands is configure terminal and interface gigether0/0/2." *See* [ARISTANDCA13356947 at Page 23] (Nov. 2003 Procket Networks CLI Basics Guide").

iv) Use of a "no" keyword before a CLI command to negate the effect of the command. *See, e.g.*, [ARISTANDCA13357887 at Pages 20-22] (2003.11 Procket System Management and Operations Guide) (showing examples of "no" keywords for particular CLI commands).

422. The Procket Networks networking products I analyzed for this Report also

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support over a hundred industry-standard CLI commands and command hierarchies that are also supported by Cisco CLIs. A detailed analysis of the overlap between the Procket Networks networking equipment CLIs and Cisco CLIs, based on the limited number of Procket Manuals that were provided to me, is provided in **Appendix H.PR**. As shown in that detailed analysis, Procket Networks has supported at least 103 of the same Cisco CLI commands that are disputed in this lawsuit. I note that this total is likely far below the actual overlap of Procket Networks CLI commands and Cisco IOS CLI commands given that I am missing several Procket Networks user manuals.

18. Quagga and Cumulus Software

423. Quagga is a routing software suite, providing implementations of OSPFv2, OSPFv3, RIP v1 and v2, RIPng and BGP-4 for Unix platforms, particularly FreeBSD, Linux, Solaris and NetBSD. Quagga is a fork of GNU Zebra which was developed by Kunihiro Ishiguro. *See* http://www.nongnu.org/quagga/index.html.

424. I have reviewed several manuals describing the Quagga and Zebra routing software suites, including:

i) "GNU Zebra - A routing software package for TCP-IP networks Zebra version 0.93b" (Sept. 2002) [ARISTANDCA13358567]

ii) "Quagga - A routing software package for TCP-IP networks"(May 2011) [ARISTANDCA13358665]

iii) "Quagga - A routing software package for TCP-IP networks"(May 2015) [ARISTANDCA13358809]

425. In my opinion, both the Zebra and Quagga routing software packages also follow and support the industry-standard CLI. For example, Quagga supports the

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industry familiar "show ip" family of commands, including commands like "show ip route", "show ipv6 route", "show interface", "show route-map", "show ip protocol", "show ip bgp" and others. Quagga also supports the "router" family of commands, like "router rip" and "router bgp", as well as the "no" command keyword prefix to disable or negate commands, like "no router rip" and "no router bgp." Other industry standard commands like "aggregate-address" and the "neighbor" family of commands like "neighbor remote-as", "neighbor shutdown", "neighbor ebgp-multihop", "neighbor description", "neighbor next-hop-self", "neighbor default-originate", "neighbor send-community", and "neighbor local-as" (as mere examples) are also supported by Quagga.

426. The full set of overlapping commands can be gleaned from visually comparing and counting up the overlaps from the disputed commands (and command fragments), and the list of Quagga commands in the above-cited manuals and on the Quagga website (*available at* http://www.nongnu.org/quagga/docs/docs-info.html). Based on my review of these materials, the following disputed CLI commands (or command fragments) are found in the same, or substantially the same form, in Quagga:

address-family	ipv6 address	passive-interface
aggregate-address	ipv6 nd managed-config-flag	passive-interface default
area default-cost	ipv6 nd other-config-flag	route-map
area range	ipv6 nd prefix	router bgp
area stub	ipv6 nd ra interval	router ospf
banner motd	ipv6 nd ra lifetime	router rip
bgp cluster-id	ipv6 nd ra suppress	router-id
clear ip bgp	ipv6 nd reachable-time	router-id (OSPFv3)

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default-information originate (OSPF)	ipv6 nd router-preference	show interfaces
default-metric (OSPF)	ipv6 ospf cost	show ip bgp
distance bgp	ipv6 ospf dead-interval	show ip bgp community
interface ethernet	ipv6 ospf hello-interval	show ip bgp neighbors
interface loopback	ipv6 ospf network	show ip bgp regexp
ip address	ipv6 ospf priority	show ip bgp summary
ip as-path access-list	ipv6 ospf retransmit- interval	show ip community-list
ip community-list expanded	ipv6 ospf transmit-delay	show ip extcommunity-list
ip community-list standard	ipv6 route	show ip ospf
ip extcommunity-list expanded	log-adjacency-changes	show ip ospf database database-summary
ip extcommunity-list standard	neighbor default-originate	show ip ospf interface
ip ospf authentication	neighbor description	show ip ospf neighbor
ip ospf authentication-key	neighbor ebgp-multihop	show ip prefix-list
ip ospf cost	neighbor local-as	show ip route
ip ospf dead-interval	neighbor next-hop-self	show ipv6 ospf
ip ospf hello-interval	neighbor peer-group (assigning members)	show ipv6 ospf interface
ip ospf message-digest-key	neighbor peer-group (creating)	show ipv6 ospf neighbor
ip ospf name-lookup	neighbor remote-as	show ipv6 route
ip ospf network	neighbor route-map	show route-map
ip ospf priority	neighbor route-reflector-client	show version
ip ospf retransmit-interval	neighbor send-community	terminal length
ip ospf transmit-delay	neighbor shutdown	timers basic (RIP)
ip prefix-list	neighbor update-source	timers throttle spf
ip protocol	neighbor weight	username sshkey

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ip route	network area	

19. Digital Equipment Corporation DECbrouter 90 Products

427. I also reviewed a "DECbrouter 90 Products Configuration and Reference Volumne 2" user manual that was produced by Cisco. *See* CSI-ANI-00081683 (First Edition, with a date of May 1993). This May 1993 manual for DECbrouter product discusses the DEC router's support for and implementation of several protocols, including DECnet, CHAOSnet, Appletalk, and IP. *Id.* at Table of Contents. The May 1993 DEC router manual also discussed the router's support for various IP routing protocols, including IGRP, OSPF, RIP, BGP, IS-IS, and ICMP. *Id.*

428. The DECbrouter 90, as shown in the May 1993 user manual, supported many of the same widely used commands at issue in this lawsuit, including, for example, a host of "show ip" commands like "show ip arp", "show ip bgp", "show ip route", "show ip traffic", "show ip interface," and others. *See* CSI-ANI-00081683 at Pages 5-44 to 5-51 (DECbrouter 90 Manual, First Edition, May 1993). Other basic commands like "show hosts", and the "no" command keyword to disable or reverse a CLI command were also supported by the DEC router in 1993. *Id.* at Pages 5-46, 5-58. Other supported commands as of May 1993 by the DECbrouter 90 product, which are now being disputed in this lawsuit over two decades later, including "ip domain-lookup", "ip domain-name", "ip name-server", "ip routing", "ip access-group", "ip helper-address", and "ip proxy-arp" *Id.* at 5-59 to 5-64.

429. The DECbrouter 90 also supported the "router" family of commands, including "router ospf" and "router rip" and "router bgp", as well as the "area" family of

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commands, like “area authentication”, “area stub”, “area default-cost”, and “area range”, all of which are in dispute in this litigation. *See* CSI-ANI-00081683 at Pages 6-14 to 6-17, and 6-24 to 6-26 (DECbrouter 90 Manual, First Edition, May 1993). It also supported the “ip ospf” family of commands, including “ip ospf cost”, “ip ospf retransmit-interval”, “ip ospf transmit-delay”, “ip ospf priority”, “ip ospf hello-interval”, “ip ospf dead-interval”, and “ip ospf authentication-key”, which are also disputed commands in this lawsuit. *Id.* at Pages 6-18 to 6-20. Many of the same “neighbor” family of commands disputed in this lawsuit, as well as “timers bgp” and “distance bgp” commands, were also supported by the DECbrouter 90 product. *Id.* at Pages 6-21, 6-27 to 6-31. “Clear” commands like “clear ip bgp” were also supported. *Id.* at 6-32. The total number of overlapping commands can be gleaned by comparing the DECbrouter 90 manual with the disputed list of commands and command fragments.

430. This early adoption by DEC in the early 1990s of what is known today as (and what has become) the industry-standard CLI appears to be one of the earliest instances of particular CLI commands becoming adopted by multiple networking vendors—in this case, DEC and Cisco.

20. Use of Cisco IOS-like CLIs as of 2003

431. I am informed and understand that Cisco filed a lawsuit against Huawei Technologies in the United States District Court for the Eastern District of Texas on or around January 22, 2003, and that lawsuit involved copyright infringement allegations. *See generally* CSI-CLI-01480494 (Cisco Systems, Inc., et al. v. Huawei Technologies, et al. Civil Docket for case No. 2:03-cv-00027-TJW). I will refer to that 2003 lawsuit as the Huawei lawsuit.

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432. I also understand that the Huawei lawsuit involved allegations that Huawei copied tens of thousands of lines of source code from Cisco IOS, as well as allegations that Huawei copied 488 CLI commands used in Cisco IOS such that over 70% of Huawei's commands were identical or substantially identical to Cisco's. *See* CSI-CLI-06135862 at 1-2, 8 (Cisco brief filed in the Huawei lawsuit in March 2003 accusing Huawei of copying 488 CLI commands from Cisco, and copying over 29,000 lines of source code from Cisco IOS).

433. [redacted]

434. I have been asked to provide an analysis of the CLIs used by non-Cisco vendors at or around the 2003 to 2004 time period, including the degree of similarities between the Cisco CLIs and the Dell and Force10 Networks, Juniper (JUNOSe), and Procket Networks CLIs at or around that period. Where third-party command reference manuals were not available during that particular time period, I used the command

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reference manuals with the closest date to the 2003 to 2004 time period. I did not have Redback Networks CLI manuals from the 2003 to 2004 time period at the time of this Report. I also note that I do not have a complete set of Procket Networks user manuals, including an IPv4 reference guide (which is mentioned within the manuals I do have). *See also* Anthony Li Dep. Tr. at 166:7-25 (discussing the missing Procket Networks manuals).

435. This analysis is based on the following user documentation:

i) [ARISTANDCA13232166] 2003.05 - Dell PowerConnect 33243348 Switch CLI Guide NATIVE.pdf

ii) [DELL-ANETSUB00123073] - Force10 - CLI-5.3.1.0.pdf

iii) [ARISTANDCA13356947] 2003.10 - Procket Networks Software Introduction Release 2.3.pdf

iv) [ARISTANDCA13357095] 2003.11 - Procket Networks IPv6 Routing Protocols.pdf

v) [ARISTANDCA13357279] 2003.11 - Procket Networks System Management and Operations Release 2.3.pdf

vi) [ARISTANDCA13357887] 2003.11 - Procket System Management and Operations.pdf

vii) [ARISTANDCA13358495] 2004.03 - Procket Networks Style Guide.pdf

viii) Juniper-E-Series Routers Command Reference A-M (19006JNPR00124303) Native OCR.pdf

ix) Juniper-E-Series Routers Command Reference N-Z

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(19006JNPR00124691) Native OCR.pdf

436. Based on my analysis, which followed the same methodology as I described earlier in this Report for the comparison of the Cisco CLI command set with the Dell CLI command set (and is therefore conservative and prone to undercounting of commands), I determined that as of the 2003 to 2004 time period:

i) Dell and Force10 together supported ***at least*** 559 valid and complete CLI commands that were exactly the same as Cisco CLI commands (of those, approximately 124 exact commands were supported by Dell, while well over 400 exact CLI commands were supported by Force10)

ii) Juniper's JUNOSe E-Series products supported ***at least*** 337 valid and complete CLI commands that were exactly the same as Cisco CLI commands.

iii) Even with the limited number of user manuals I have, Procket Networks supported ***at least*** 224 valid and complete CLI commands that were exactly the same as Cisco CLI commands.

A list of those overlapping CLI commands are provided in **Appendices J.1, J.2, and J.3**.

437. Based on this analysis, there were several vendors who--during the same time that the Huawei litigation was pending in 2003 and 2004--supported hundreds of exact, valid Cisco IOS CLI commands. For the reasons stated above, as well as the reasons stated in my description of the command matching methodology, the above counts are conservative.

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C. Cisco's Awareness of Cisco IOS-like CLIs in the Market, and Characterization of its CLI as "industry standard."

438. [redacted]

439. I have also reviewed the deposition testimony of several Cisco witnesses,

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and documents used in those depositions, that confirm that Cisco itself understood or at least characterized the Cisco IOS CLI as "industry standard." *See, e.g.*, Remaker Dep. Tr. at 112 and associated exhibits. And as discussed in the vendor-specific sections above, many of Cisco's competitors openly advertised their support of the *de facto* industry standard CLI, or even a "Cisco-like" or "IOS-like" CLI, and Cisco employees--like Mr. Remaker and Mr. Li--were well aware of it as early as the late 1990s. *See* Remaker Dep. Tr. at 150; *see also* Anthony Li Dep. Tr. at 158-163, 228; Kathial Dep. Tr. (rough) at 47, 56; CSI-CLI-02246711 at 6 (Brocade "features an industry standard CLI"); CSI-CLI-0564048 at 7 (Dell has an "Industry-standard CLI"); CSI-CLI-04057694 at 16 ("Redback has implemented an industry standard CLI"); CSI-CLI-06018032 at 21 (Nexthop has an "Industry Standard CLI"); CSI-CLI-06023246 at 4 (HP offers "Industry-standard CLI with a hierarchical structure"). Indeed, Cisco acquired Procket Networks in 2004, and therefore must have been aware that Procket's CLI was a clone of the Cisco IOS CLI.

440. This evidence shows that Cisco was well aware that its CLI had become a *de facto* industry standard across the networking industry.

D. **CLI usage in multi-vendor network management products.**

i) <u>Cisco/Tail-f Networks Services Orchestrator (NSO) and ConfD Products</u>

441. I have reviewed documentation and source code relating to Cisco's (formerly Tail-f's) Network Services Orchestrator (NSO) product, including documentation and datasheets produced in this litigation by both Arista and Cisco. I have also reviewed documentation and datasheets produced in this litigation relating to Cisco's ConfD product. Such documents include:

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- "Tail-f Network Control System 3.3 Getting Started Guide" (CSI-CLI-04633845 to CSI-CLI-04633964)
- "Cisco NSO 4.1 Getting Started Guide" (CSI-CLI-03837281 to CSI-CLI-03837358)
- "NSO 4.1 NED Development" (CSI-CLI-03838281 to CSI-CLI-03838382)
- "Network Services Orchestrator enabled by Tail-f" (CSI-CLI-04675741 to CSI-CLI-04675743)
- "Overview of Tail-f Network Control System" (CSI-CLI-01752368 to CSI-CLI-01752413)
- "Tail-f ConfD User Guide" (ConfD 3.3) (CSI-CLI-03693824 to CSI-CLI-03694673)
- "Tail-f ConfD User Guide" (ConfD 6.1) (CSI-CLI-03836272 to CSI-CLI-03837265)
- "Cisco NSO 4.1 Manual Pages" (CSI-CLI-03837527 to CSI-CLI-03838044)
- "Cisco NSO 4.1 User Guide" (CSI-CLI-03838383 to CSI-CLI-03838540)
- "Tail-f NCS (Network Control System) Overview for Verizon Wireless" (CSI-CLI-04612168 to CSI-CLI-04612189)
- "Tail-f NCS Overview" (CSI-CLI-04615047 to CSI-CLI-04615069)
- "Leveraging Tail-f NCS into Cisco's Product and Solutions Offerings" (CSI-CLI-04624502 to CSI-CLI-04624504)
- "NCS 3.4 User Guide" (CSI-CLI-04656586 to CSI-CLI-04656739)
- "Tail-f Technology Overview [to Morgan Stanley]" (CSI-CLI-04659648 to CSI-CLI-04659685)

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- "ConfD Evaluation Kick Start Guide" (CSI-CLI-04613894 to CSI-CLI-04613930)
- "ConfD CLI" (CSI-CLI-04995547 to CSI-CLI-04995548)
- "Tail-f Systems XML-based Network Management Software" (CSI-CLI-05035841 to CSI-CLI-05035936)
- "Tail-f Systems Technology Brief: Creating and modifying network services using Tail-f NCS" (CSI-CLI-04661077 to CSI-CLI-04661091)
- Several Tail-f email communications, including: CSI-CLI-05134503 to CSI-CLI-05134505; CSI-CLI-05173487 to CSI-CLI-05173488; CSI-CLI-05282653 to CSI-CLI-05282654

442. I have also reviewed YouTube videos, published by Cisco/Tail-f, that discuss and demonstrate the Tail-f ConfD and NCS products, including:

- https://www.youtube.com/watch?v=RkOmKhrU3og (ARISTANDCA13365355)
- http://techfieldday.com/appearance/tail-f-systems-presents-at-networking-field-day-7/

443. I also reviewed the Cisco NSO product FAQ on the Cisco DevNet public website: https://developer.cisco.com/site/nso/help/faq/

444. As part of my review of the Cisco NSO product, I also reviewed source code for the Cisco NSO product, which Cisco made available at a review computer located at Quinn Emanuel's San Francisco offices.

445. I have also reviewed the transcript from the corporate deposition of Tail-f designee Johan Bevemyr ("Bevemyr Dep. Tr.") relating to the Cisco NSO and ConfD products, as well as the individual deposition transcript of Carl Moberg ("Moberg Dep.

Tr.”). Mr. Bevemyr served as Chief Software Engineer at Tail-f Systems, and is currently a Principal Engineer at Cisco. Mr. Moberg served several roles at Tail-f Systems, including VP Engineer, COO, and VP Technology, and is currently Technology Director at Cisco.

446. I understand that Cisco acquired Tail-f Systems in 2014. *See* Bevemyr Dep. Tr. at 11; Moberg Dep. Tr. at 26. I also understand that prior to being acquired by Cisco, Tail-f Systems sold two products called ConfD and Network Control System (“NCS”). I understand that Cisco continues to make ConfD available to customers, and that Cisco renamed the Tail-f NCS product as the Cisco NSO product because Cisco already sold a product called NCS when it acquired Tail-f. *See* Bevemyr Dep. Tr. at 14; Moberg Dep. Tr. at 21-22. In this report, I will discuss the functionality of the Cisco NSO / Tail-f NCS product (which I will refer to for simplicity as the Cisco NSO product), as well as the Tail-f ConfD product.

447. The Cisco NSO product is intended to simplify the process of provisioning services in both physical and virtual networks by decoupling network services from specific components, and automatically configuring the network according to the service specifications. The Cisco NSO product purports to have the industry’s broadest multi-vendor device support, and provides centralized control of all devices and services in a customer’s multi-vendor network. *See e.g.* CSI-CLI-03837281 at 2; CSI-CLI-05982743 at 5.

448. [redacted]

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[redacted]

[redacted]

449. [redacted] The Cisco NSO FAQ also states that "Tail-f provides NEDs to Juniper, Cisco, Alcatel-Lucent, Ericsson, A10, F5, Brocade, HP, Huawei, and others." https://developer.cisco.com/site/nso/help/faq/#which-types-of.

450. [redacted] When committing changes to the network, a user can choose different strategies (require all devices to support all changes, or skip changes to devices not supporting them). https://developer.cisco.com/site/nso/help/faq/#how-does-NSO-deal.

451. [redacted]

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[redacted]

452. [redacted]

453. [redacted]

[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]			[redacted]	

454. [redacted]

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[redacted]

455. [redacted]

456. [redacted]

457. [redacted]

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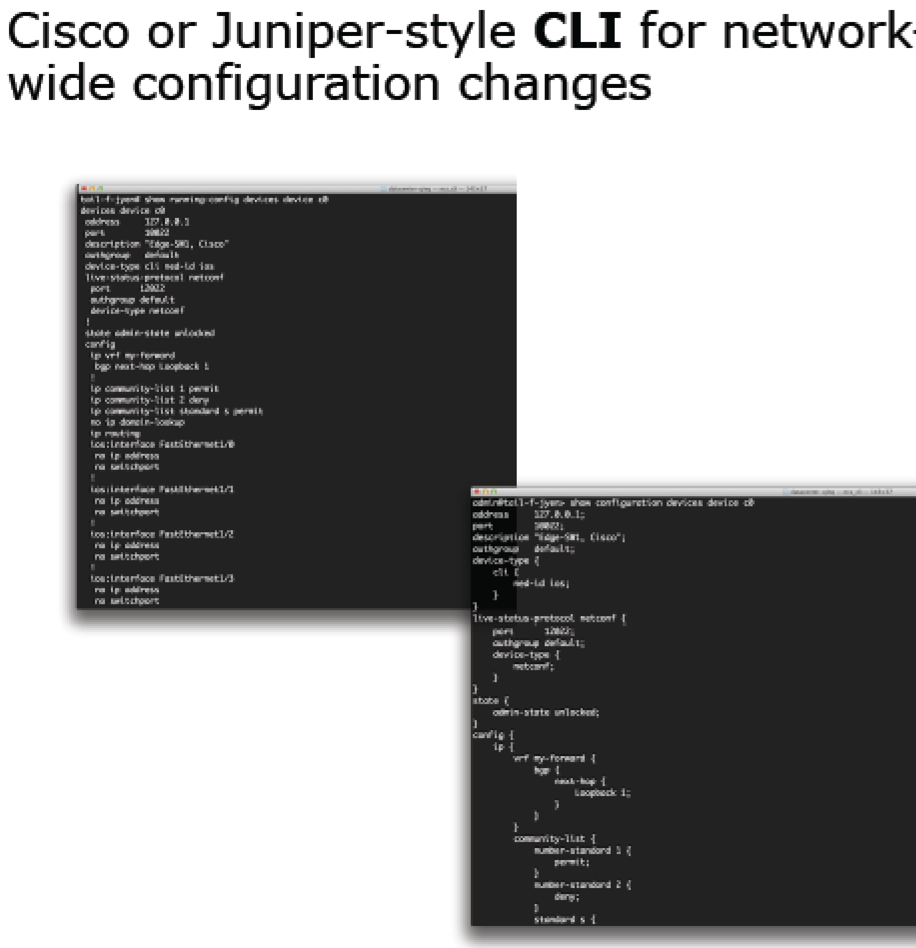
[redacted]

458. [redacted]

459. [redacted]

[redacted]

460. A presentation from Cisco Connect Toronto on May 13-14, 2015, entitled "NCS: Network Control System Hands-on Lab", illustrates the two different user-facing CLI options. *See* ARISTANDCA00268178 at 19.



461. [redacted]

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[redacted]

462. [redacted]

463. [redacted]

464. [redacted]

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[redacted]

465. [redacted]

466. [redacted]

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467. [redacted]

468. [redacted]

469. [redacted]

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[redacted]

470. [redacted]

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[redacted]

[redacted]

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471. [redacted]

ii) <u>CiscoWorks Network Compliance Manager (NCM)</u>

472. I have reviewed documentation and materials produced by Cisco relating to Cisco's CiscoWorks Network Compliance Manager ("NCM") product. I have also reviewed documentation and materials produced by Hewlett Packard Enterprise ("HPE") in response to a third-party subpoena issued to HPE in this lawsuit.

473. I have also reviewed the deposition transcript of the corporate designee of HPE, Mr. Balaji Venkatraman, relating to the functionality of the CiscoWorks NCM product, which both HPE and Cisco have confirmed is the same product (albeit

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rebranded) and shares the same relevant and core functionality as the HPE Network Automation product. HPE Dep. Tr. at 29-30, 35-36. HPE describes the CiscoWorks NCM product as the "OEM Version" of the NPE Network Automation product. *Id.* at 21.

474. Even the versioning of the products were coordinated (for example, HPE Network Automation version 9.2 is the same as CiscoWorks NCM version 1.8, and HPE Network Automation version 8.3 corresponds to CiscoWorks NCM version 1.7), and Cisco did not have the ability to add to or change the core functionality of the product. HPE Corp. Dep. Tr. (Venkatraman) at 30-38. Technical support for issues that Cisco technicians could not answer were also handled by HPE engineers. *Id.* at 40. Documentation for the two products as also substantially similar and, for overlapping content, is created at the same time. *Id.* at 54, 82-83. HPE has owned the HPE Network Automation product since acquiring it from its purchase of Opsware in 2007. *Id.* at 23-24.

475. I have also reviewed the deposition transcript of Cisco's corporate designee, Beecher Adams, regarding the functionality of the Cisco NCM product and its relationship between HP Network Automation product.

476. I understand that the CiscoWorks NCM product has been given an "End of Life" status by Cisco and that HPE has been running a program to migrate CiscoWorks NCM customers to the HPE Network Automation product since 2013, which is when Cisco stopped selling new copies of the NCM product. *See* ARISTANDCA00224900; HPE Corp. Dep. Tr. at 31-33. I also understand that Cisco stopped supporting the NCM product in March 2016. HPE Corp. Dep. Tr. at 37-38.

477. As explained by HPE and Cisco's corporate witnesses, and as also

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explained in CiscoWorks NCM documentation, the CiscoWorks NCM product is focused on monitoring the configuration of "network elements" (*e.g.*, routers and switches) in a multi-vendor network. HPE Corp. Dep. Tr. at 23-25. The CiscoWorks NCM product also detects changes to the configurations of those network elements, and if the configuration is in violation of a network policy (or policies), the product makes a change or recommends a change to the network configuration so that the network elements come back into compliance. *Id.*

478. [redacted]

479. [redacted]

480. [redacted]

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[redacted]

481. [redacted]

[redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted]

[redacted] [redacted]

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(ARISTANDCA00265918)

[redacted]

482. [redacted]

[redacted]

483. The CiscoWorks NCM and Cisco NSO products are not the only commercial products designed to help customers automate the management, configuration, and provisioning of multi-vendor networks using, among other means of communication, vendor- and device-specific CLI commands, hierarchies, modes, prompts, and responses to communicate with each of the different devices in a multi-vendor network. The HP Network Automation product, which HP's corporate witness Mr. Venkatraman discussed at his deposition, is an example of a non-Cisco product that provides that functionality, and Mr. Venkatraman discussed several other competitors--including InfoBlox and IBM--as operating in the same space. HP Corp. Dep. Tr. at 78-79. All of those products, given their core functionality, use both Cisco and third-party (non-Cisco) CLIs to issue vendor- and device-specific CLI commands to network devices, and to understand the vendor- and device-specific CLI command responses that may be returned by the devices.

VIII. TECHNICAL ISSUES RELATED TO THE ACCUSED COMMANDS

484. In my analysis of the accused and supposedly copied CLI "commands" identified in Exhibit 1 to Cisco's original and Second Amended Complaint, as well as the list of "commands" identified in the various versions of Exhibit F (including all amendments thereto) to Cisco's responses to Arista's Interrogatories, I have discovered certain technical issues and inconsistencies regarding those "commands."

485. The list of "commands" attached as Exhibit 1 to Cisco's Second Amended Complaint and provided in Cisco's Exhibit F to its discovery responses are not the same,

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and those lists also differ from, for example, Exhibit B to Cisco's discovery responses. I understand that Cisco has supplemented Exhibit F to its discovery responses on several occasions (and more recently than Exhibit B to its discovery responses), and that certain command-specific discovery ordered by the Court relating to each of Cisco's asserted commands was provided by Cisco via these Exhibit F supplementations. I therefore treat Exhibit F as the most operative list of Cisco's disputed "command expressions."

486. Some purported "commands" in Exhibit 1 to the operative complaint are missing from Cisco's Exhibit F to its discovery responses. Specifically:

- The supposed "ip igmp snooping querier version" command, which appears in Exhibit 1 to Cisco's Second Amended Complaint, does not appear in Exhibit F to Cisco's discovery responses. Since Cisco has not provided any discovery, including "authorship" information, regarding this "command," and excluded the "ip igmp snooping querier version" in Exhibit F to its discovery responses, I will assume that Cisco is not asserting it as part of its allegations.
- The supposed "passive-interface (IS-IS)" command, which appears in Exhibit 1 to Cisco's Amended Complaint, does not appear in Exhibit F to Cisco's discovery responses. Since Cisco has not provided discovery, including "authorship" information, regarding this "command," I will assume that Cisco is not asserting it as part of its allegations.
- The supposed "show ip bgp neighbors (route type)" command,

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which appears in Exhibit 1 to Cisco's Amended Complaint, does not appear in Exhibit F to Cisco's discovery responses. Since Cisco has not provided discovery, including "authorship" information, regarding this "command," I will assume that Cisco is not asserting it as part of its allegations.

- The supposed "show ipv6 bgp neighbors (route type)" command, which appears in Exhibit 1 to Cisco's Amended Complaint, does not appear in Exhibit F to Cisco's discovery responses. Since Cisco has not provided discovery, including "authorship" information, regarding this "command," I will assume that Cisco is not asserting it as part of its allegations.
- The supposed "show flowcontrol" command, which appears in Exhibit 1 to Cisco's Amended Complaint, does not appear in Exhibit F to Cisco's discovery responses. Since Cisco has not provided discovery, including "authorship" information, regarding this "command," I will assume that Cisco is not asserting it as part of its allegations.

487. In addition, Exhibit F to Cisco's discovery responses contain some purported "commands" that were never alleged by Cisco as being "copied" by Arista in the Second Amended Complaint. In particular, Cisco has introduced three new purported commands--"ip-community-list standard", "isis passive-interface," and "show interfaces flowcontrol"--in Exhibit F to its discovery responses, which do not appear in its Exhibit 1 to its Second Amended Complaint.

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488. In addition, I note that three of the accused Arista "commands" are, on their face, different from the corresponding Cisco IOS "commands" that Cisco alleges were copied. For example, in Exhibit B to Cisco's responses to Arista's interrogatories, Cisco accuses Arista of copying the "clear mac-address-table dynamic," "show interfaces flowcontrol," "show policy-map control-plane," and "show policy-map interface" commands, but the Arista EOS CLI commands that Cisco accuses and identifies in its Exhibit B are different. Respectively, according to Exhibit B to Cisco's discovery responses, Cisco accuses the supposed Arista CLI commands "clear mac address-table dynamic" (hyphenation is different), "show flowcontrol" (missing the word "interfaces"), "show policy-map type control-plane" (additional word "type"), and "show policy-map interface type qos" (additional words "type qos").[96]

489. Furthermore, several of the accused "commands" appear syntactically identical as identified by Cisco and differ only in that they are supposedly being run for different routing protocols. For example, the following purported commands are accused separately by Cisco for different versions of OSPF (versions 2 and version 3), and in one case also for IS-IS, despite the words in the accused command being the same:[97]

- "area default-cost"
- "area nssa"
- "area nssa default-information-originate"

---

[96] The list of supposedly copied Cisco CLI commands in Exhibit B to Cisco's interrogatory responses is also different from the list of "commands" Cisco identified in Exhibit 1 to its Amended Complaint. Cisco's most recent identification of accused commands, however, was provided in its supplemental Exhibit F to its interrogatory responses, and therefore I will follow that list.

[97] Cisco uses a parenthetical after the accused command to indicate whether they are accusing a command for a particular version of a routing protocol, like OSPF version 3. *See, e.g.*, Cisco's Eighth Suppl. Exh. F to Arista's Interrogatories. However, the parenthetical text is not part of the command text that is entered into the Cisco or Arista CLI.

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- "area nssa translate type7 always"
- "area range"
- "area stub"
- "default-information originate"
- "default-metric"
- "log-adjacency-changes"
- "maximum-paths"
- "passive-interface"
- "router-id"

490. Cisco also lists the purported "neighbor peer-group" command twice, and identifies in a parenthetical that one command is for "assigning members" and another is for "creating." The words in parentheses are not typed into the CLI as part of the command.

491. In the course of analyzing the accused "commands" for purposes of this Report, I also observed that many of the so-called "commands" disputed in this litigation are not syntactically valid commands that the Cisco IOS CLI parser and/or the Arista EOS CLI parser would accept as a valid and complete command. In other words, many of the accused "commands" are not valid CLI commands at all, but would trigger an incomplete command error from the CLI if entered by an end user because they are missing additional parameters that must be provided before the parser will perform the command's associated functionality. These incomplete commands can be seen when comparing the list in Exhibit 1 to Cisco Second Amended Complaint (or the list in Exhibit F to Cisco's discovery responses) to the command reference user documentation

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pertaining to each such command (or fragment).

492. I may refer to the accused CLI "commands" throughout this Report as simply the accused commands, without indicating that some accused "commands" are not actually complete and syntactically valid CLI commands. However, this observation and the important distinction between valid and incomplete commands, and Cisco's inconsistent approach in selecting a seemingly arbitrary collection of complete and incomplete CLI commands, applies to all portions of my Report.

493. I also note that several of the accused Arista CLI commands, and several purportedly copied Cisco CLI commands, are not valid commands at all. For example:

- ○ The "ip-community-list standard" command does not appear to be a valid command documented in any Cisco user manual, and is not a valid command recognized by the Arista EOS CLI.
- ○ The "isis passive-interface" command does not appear to be a valid command documented in any Cisco user manual, and is not a valid command recognized by the Arista EOS CLI.
- ○ The "default-metric" command is not supported by Arista for OSPF version 2, as Cisco contends.

494. Moreover, some of the accused commands serve an entirely different functional purpose in Arista EOS than the Cisco IOS command that Cisco contends is similar. For example, the "ip protocol" command supported by the Arista EOS CLI configures a "Monitor Reachability Probe Transmitter" feature that is unique to Arista's switches. *See* CSI-CLI-06302874 at 2133 (Arista Networks User Manual for Arista EOS v.4.15.3F) ("The ip protocol command specifies the IP protocol that the switch uses to

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send probe packet through the configuration mode probe transmitter."). The command functionality is completely different in the Arista EOS CLI as compared to the function that any "ip protocol" command might perform in Cisco's switches. *See* CSI-CLI-00344775 at WAN-250 (Cisco WAN manual describing the "ip protocol" command as being used "[t]o configure the Layer 2 Tunnel Protocol (L2TP) or Universal Tunnel Interface (UTI) as the IP protocol used for tunneling packets in a Layer 2 pseudowire[.]").

495. Similarly, the accused "max-connections" command performs functionality relating to Arista's LANZ (Latency Analyzer) feature, which is an innovative Arista feature discussed elsewhere in this Report. *See* CSI-CLI-06302874 at Page 2069 (Arista Networks User Manual for Arista EOS v.4.15.3F) ("The max-connections command sets the maximum number of client connections the switch accepts for streaming LANZ data."). Since Cisco does not have a feature called LANZ, the command functionality is completely different in the Arista EOS CLI as compared to the function that any "max-connections" command might perform in Cisco's switches.

496. I have not been able to locate a "max-connections" command in any Cisco command reference manuals related to Cisco IOS, NX-OS, or any other flavor of Cisco IOS, and the documents cited as the "Earliest Known Document" in the most recent Exhibit F to Cisco's discovery responses (CSI-CLI-01339845, CSI-CLI-01339873) make no mention of a "max-connections" command. I have seen no evidence that this is a valid Cisco IOS CLI command, and certainly no evidence that it performs any function similar to the Arista EOS "max-connections" command.

497. Given that Cisco's list of allegedly copied Cisco IOS commands is

inconsistent between Exhibit 1 to its Second Amended Complaint, Exhibit B to Cisco's Supplemental Interrogatory Responses, and the various iterations of Exhibit F to Cisco's Supplemental Interrogatory Responses, including missing and extra hyphens that appear and disappear in certain "command expressions," I reserve all rights to supplement these opinions herein if Cisco presents a different list of allegedly copied Cisco CLI features, including CLI commands, hierarchies, modes, prompts, and responses.

484. ANALYSIS OF COMMANDS AND CLI FUNCTIONALITY DERIVING FROM STANFORD CODE.

498. I have also reviewed documentation and other materials, including source code produced by Cisco and Kirk Lougheed, relating to the origins of the Cisco's first routing products, including the following materials:

- ○ Transcript from the Deposition of Kirk Lougheed (Volumes I and II) (Nov. 20, 2015 and Apr. 4, 2016) and exhibits thereto.
- ○ Several versions of the [redacted]
- ○ "Cisco Systems AGS User Manual" [CSI-CLI-00358166]
- ○ "Cisco Systems ASM/AGS User Manual and Configuration Guide" [CSI-CLI-00358622]

[redacted]

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[redacted]

499. Based on my review of the above documentation and materials, including the above-cited source code, the following CLI command modes were used in and supported by the "Cisco fork" (as Mr. Lougheed described it) of the Stanford EECF software:

- ○ "Privileged Mode" [Lougheed Dep. Tr. at 365 - 367]
- ○ "Non-Privileged Mode" [Lougheed Dep. Tr. at 365 - 367]

500. I understand from Mr. Lougheed's deposition testimony that, [redacted] I also understand from Mr. Lougheed's deposition that [redacted]

501. I also understand that Mr. Lougheed [redacted]

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[redacted] I further understand from Mr. Lougheed's deposition testimony that [redacted]

502. As explained by Mr. Lougheed, the [redacted]

503. Based on my review of the above documentation and materials, the following CLI command modes were used and supported in the Stanford SUMEX software developed by William Yeager at Stanford:

- "Privileged Mode" [Lougheed Dep. Tr. at 365 - 367]
- "Non-Privileged Mode" [Lougheed Dep. Tr. at 365 - 367]

504. As explained by Mr. Lougheed, [redacted]. According to Mr. Lougheed, [redacted]

[redacted]

505. In my opinion, the idea behind these two "privileged modes" is the same: it permits a user who enters the "privileged" mode of operation to access certain privileged CLI commands, while users who use the software in the "nonprivileged" mode of operation may not access those privileged CLI commands.

506. The same concept is seen in the "root" account in a Linux or Unix-like operating system, which, similar to a "privileged mode" user, has access to all commands and files, while non-"root" users typically do not have access to all commands and files.

507. The same idea is also seen in the accused "EXEC" and "Privileged EXEC" user modes in the Arista EOS CLI. The "EXEC" and "Privileged EXEC" modes of operation in the Arista EOS CLI (and also in the Cisco IOS CLI) differ in that the "Privileged EXEC" mode allows access to a certain set of "privileged" CLI commands that cannot be accessed or executed in the nonprivileged "EXEC" mode of operation. [Lougheed Dep. Tr. at 380 - 382]; CSI-CLI-06302986; CSI-CLI-00350081-00350082; *See also* discussion of command modes elsewhere in this report.

508. Based on my review of the above documentation and materials, [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted]

509. Moreover, the "Cisco-fork" of the Stanford EECF software also supported the use of the command keyword "no" before a CLI command to negate or undo the effect or functionality of a command in the EECF software.

510. [redacted]

511. The foregoing CLI features, including accused command modes, prompts, and "command expressions" were therefore not original to Cisco, and taken from non-Cisco software.[98]

[98] Cisco witness Kirk Lougheed also admitted to Cisco copying directly from Stanford EECF user documentation to write Cisco user documentation for Cisco's first commercial "ASM/AGS" networking product. *See* Lougheed Dep. Tr. at 387-396; *see also* CSI-CLI-01315526 (Stanford Ethertip/Gateway User

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512. Mr. Lougheed also confirmed at his deposition that several aspects of the CLI supported by the SUMEX software at Stanford, which was developed by William Yeager, already supported "common" CLI functionality found in most CLI parsers. In particular, Mr. Lougheed confirmed that the SUMEX software supported command completion functionality, the ability to detect whether the user had entered sufficient text to identify a unique command, and a context-sensitive help system triggered by a question mark "?" character. Mr. Lougheed further admitted that he was familiar with these CLI features in the SUMEX software (which are all described in a SUMEX command reference manual with Mr. Lougheed had in his files) before he left Stanford to join Cisco. As Mr. Lougheed explained when asked about the CLI parser functionality described in Mr. Yeager's SUMEX software user documentation:

> A. ***It is a common technique in any parser***, any command parser, that -- not in all command parsers but in many of them, that it has a list of all of the commands internally. And ***if it can figure out by the first initial characters that you type, it has to be this particular command***, then it will -- you can only -- ***you only need to type those very first few characters***. "Recognition" he appears to be using as you can -- I believe the way he's using it is that if you typed the beginnings of a valid command and it was not -- if it was a unique valid beginning and you hit "escape," ***it***

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and Configuration Guide); CSI-CLI-00358622 (plagiarised Cisco ASM/AGS User Manual).

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> ***would complete the command***. It would fill out the command. And if it was ambiguous -- and in this case he's using two commands that begin with T and if you type "T," it would sound a bell character -- it would sound a bell and refuse to do anything. And he also mentions something that I would call ***context sensitive help*** that you can type "T" and a question mark and it will tell you what commands were possible completions for that T.

Lougheed Dep. Tr. at 233-235 (emphasis added); *id.* at 235 (confirming that the SUMEX parser actually supported this functionality described in the user manual); KL-00000001 (Stanford SUMEX reference manual entitled "A Multiple Protocol Kernel for Local Area Network Software Development Reference Manual" that Mr. Lougheed had in his files).

513. These common CLI features also pre-date the Cisco IOS CLI, and were already known to Cisco's first engineers before they copied and replicated those features in the Cisco IOS CLI.

514. I have reviewed the source code produced by Mr. Lougheed for the Cisco-fork of the Standard EECF software, as well as the source code for Mr. Yeager's SUMEX software. There are obvious similarities between the source code, including the source code underlying the parser functionality. For example, [redacted]

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[redacted] Mr. Lougheed confirmed at his deposition that [redacted]

515. I understand that Mr. Lougheed admitted at his deposition [redacted]

516. Finally, Mr. Lougheed admitted that he did not create the Privileged EXEC command mode in Cisco IOS, which operates as a subset of the “”user” (or User EXEC) command mode, but instead credited Mr. Yeager (the Stanford employee who wrote the Stanford SUMEX source code) as the source of that command mode:

> **Q.** … [W]hen you say "exec" command mode, is that the same thing as the "user exec" command mode?
>
> **A.** Yes. ...
>
> **Q.** … Is there a "privilege[d] exec" command mode in Cisco IOS?

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A. Yes.

Q. And what is the difference between the "privilege[d] exec" command mode in Cisco IOS and the "user exec" command mode in Cisco IOS?

A. The one is a subset of the other.

Q. Which one is a subset of the other?

A. The "user" command mode.

Q. And ***are you the creator of the "privilege[d] exec" command mode*** in Cisco IOS?

A. ***I base that ultimately on Mr. Yaeger's [sic] work.***

See Lougheed Dep. Tr. at 381-382. Mr. Yeager no doubt took this convention directly from TOPS-20 which has a non-privileged mode called "EXEC" and a privileged mode invoked by typing the command "ENABLE." A privileged user can revert to non-privileged mode using the command "DISABLE." *See* ARISTANDCA00038298 (TOPS-20 Manual). All of these behaviors from TOPS-20 were presumably familiar to Mr. Lougheed given that he was a DECSYSTEM-20 systems programmer at Stanford, and these computers ran TOPS-20. [Lougheed Dep. Tr. at 42-43, 49-50] These same behaviors, with the same commands invoking them, found their way into Mr. Yeagar's SUMEX code, then into Mr. Lougheed's EECF code, and then into Cisco's first IOS versions and into all industry standard CLIs in the networking space.

IX. ANALYSIS OF ISSUES RELATED TO COPYRIGHTABILITY OF ASSERTED PARTS OF THE COPYRIGHT WORKS

A. The elements of the Cisco CLI Cisco accuses Arista of copying are part of a method of operation

517. As noted above, I understand that copyright protection does not extend to ideas contained in a work, or to procedures, processes, systems, methods of operation, concepts, principles or discoveries. I also understand that under the doctrine of merger, if the idea, system or method of operation, on the one hand, and the expression, on the other, merge, the expression becomes unprotected.

518. I have been asked to consider whether, or to what extent, the aspects of Cisco's CLI that are the bases of the copyright infringement claim constitute a system or a method of operation. As explained above, the asserted CLI keywords are, in a number of instances, incomplete fragments of commands. As such, it is not clear what value or merit--whether functional or expressive--these command fragments have since entering them into the command line would result in an error. Nonetheless, for purposes of this analysis I will treat the asserted complete commands and the command fragments similarly, and will accept Cisco's assertion that they are all part of a larger set of command words that have been used with various versions of Cisco's operating systems over the years. I will refer to them all as the asserted CLI commands.

519. [redacted]

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[redacted]

520. With particular regard to the Arista parser--the part of the source code that reads and processes command words and arguments--I understand that it was written entirely by Arista engineers. *See, e.g.*, Sweeney Dep. Tr. (Jan. 29, 2016) at 124:21-25 ("Our entire parser and the entire software implementation is completely different from anything at Cisco"); Duda Dep. Tr. (Feb. 12, 2016) ("Our implementation is entirely our own creation.

It's completely independent of Cisco's and incorporates no Cisco intellectual property."); Holbrook Dep. Tr. (Feb. 19, 2016) at 216 ("We write all of our own code here."). I mention these facts again to clarify that what Cisco has alleged to have been copied is NOT source code that operates Cisco switches, or even the small part of the Cisco code that responds to some of the asserted CLI commands. *See, e.g.*, Holbrook Dep. Tr. (Feb. 19, 2016) at 217 (Cisco's attorney telling Arista engineer Hugh Holbrook at his deposition that "there are no allegations that Arista has stolen Cisco's source code.").

521. Additionally, the asserted CLI commands that Cisco alleges to have been copied are nowhere published as a "work." Even in Cisco manuals the CLI does not

appear in the form Cisco is asserting in this case. There are descriptions of commands, but these are typically explanations of how to construct different commands and what syntax they follow. For example, the asserted CLI command "area nssa translate type7 always" appears in Cisco manuals as follows, with both typographical errors as well as optional parameters shown in brackets:

area nssa translate

To configure a not-so-stubby area (NSSA) and to configure the OSPF Forwarding Address Suppression in Translated Type-5 LSAs feature, use the **area nssa translate**command in router address family topology or router configuration mode. To remove the NSSA distinction from the area, use the **no** form of this command.

area nssa translate commandarea *area-id* **nssa translate type7 [always] [suppress-fa] [default-information-originate [metric** *ospf-metric*] **[metric-type** *ospf-link-state-type*] **[nssa-only]] [no-ext-capability] [no-redistribution] [no-summary]**

no area *area-id* **nssa translate type7 [always] [suppress-fa] [default-information-originate [metric** *ospf-metric*] **[metric-type** *ospf-link-state-type*] **[nssa-only]] [no-ext-capability] [no-redistribution] [no-summary]**

CSI-CLI-00296282 ("Cisco IOS IP Routing: OSPF Command Reference") (Cisco IOS 15.4).

522. To my knowledge, Cisco does not publish a list similar to Exhibit 1 to the complaint. Other non-literal aspects of Cisco's code that are allegedly copied are the abstract hierarchy of certain commands, the fact that EOS operates under modes similar to those found in versions of Cisco operating systems, and that there are some similarities in formatting of some responses that are printed on a screen in responses to certain commands. I have considered all of these non-literal aspects of Cisco's asserted works and am of the opinion that these aspects comprise (together with the other recognized CLI commands, arguments, parameters and other command responses not asserted) a method of operation for controlling a Cisco device. Individually, some of these aspects of the Cisco CLI are nothing more than a concept or a system. There are several reasons

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why these aspects comprise a system or a method of operation.

523. Each of the asserted CLI commands listed in Exhibit 1 to the Complaint serve the sole purpose of enabling a network administrator to adjust a setting, reveal a status, or enable a feature on the corresponding network device. In essence, these commands are nothing more than a means to invoke a functionality, much like a physical knob on older vintage electronics.[99] Indeed, many in the networking industry refer to the settings that one can access via CLI commands as "knobs." Taken together, the asserted CLI commands, together with all of the other CLI commands, constitute a group of controls to administrator to manage, operate, and report on the status of the device. In this sense, the sum total of the commands recognized by any Cisco operating system (or any operating system) are the controls that unlock the functionality of that operating system or its associated hardware. This set of controls is, in my opinion, a system or a method of operation.

524. As further demonstration of this fact, the asserted CLI commands (or fragments), as a rule, do not appear as they are listed in Exhibit 1 within Arista's source code. Thus, Cisco appears to base its contention that Arista's EOS software infringes Cisco's copyrights on the assertion that Arista designed the EOS parser to perform the *function* of parsing certain text strings that are also parsed by Cisco's IOS parser, even though Arista wrote its parser code from scratch, and without reference to Cisco's parser code. This is a purely functional relationship--further confirming that the asserted CLI commands are a method of operation (i.e., they are something that the accused software recognizes according to one of its functions, generally not part of the accused software

[99] Terry Slattery described Cisco's CLI as the "mechanism for how their customers access control and configure and manage their devices." Slattery Dep. Tr. at 149.

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itself).

525. [redacted]

526. Another aspect of parsing of the CLI commands supports my conclusion that the asserted aspects of Cisco's CLI constitute a method of operation. In practice, it is rare for a network administrator to enter the full character string of a command word. These command words become so familiar to network administrators that they take advantage of any possible shortcut to typing out multi-word commands. Much more often the network administrator will only enter the first few characters of each command word and allow the software to "auto-complete" so long as there is only one valid

[100] This claim relates to the source code versions of the respective parsers I have seen. That is, Arista EOS 4.15 and Cisco IOS 12.4.

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command keyword that could correspond to the entered characters.[101] For example, the full command to enter Privileged EXEC mode for any industry standard CLI is "enable." But I never type that; instead I just type "en". Similarly I type "sh ip int br" for "show ip interface brief" and I type "conf t" for "configure terminal." I have typed these abbreviations so many times now that any networking device that actually required me to type the words out in full would be quite frustrating to use.

527. As Cisco corporate witness Phillip Remaker confirmed at his deposition:

> **Q.** … Why is it important when creating a new CLI command to watch for collisions?
>
> **A.** Typically customers using the CLI will type abbreviated forms of the command. For example, they might type "sh," space, "int" instead of typing out "show interface" in its completeness. If a top level command starting with the letters "sh" was created, suddenly a customer typing "sh," space "int" would get an error because more than one command started with the letters "sh." That would be an example of a collision.
>
> **Q.** So, for example, if a Cisco engineer were to propose a hypothetical command "share interface," a customer typing in "sh," space, "int" would receive an error, correct?

---

[101] *See, e.g.*, Berly Dep. Tr. at 235-236; Anthony Li Dep. Tr. at 226-227; Remaker Dep. Tr. at 149-150.

A. Correct.

Cisco Corp. Dep. Tr. (Remaker) at 63:11-64:1.

528. Consequently, most often the majority of network administrators do not use the "expression" that Cisco asserts in this case. Instead, they type only as many letters as are necessary to unambiguously specify the desired keyword. The "words" in the asserted CLI commands serve little or no purpose to a familiar user; all that matters are enough beginning letters to distinguish a keyword. This further indicates that the aspects of the CLI asserted are merely part of a system or method of operation as opposed to creative expression.

529. The "hierarchy" of the asserted CLI commands is necessarily part of the same method of operation as described above. Cisco describes its "hierarchies" as follows: "Within a given command hierarchy, all of the commands start with the same word; for example, all of the commands within the "aaa" command hierarchy start with "aaa."[102] To the extent this is a hierarchy, Cisco has defined it as the concept of grouping commands by a common first word (or for sub-hierarchies, by a common second word, etc.). Cisco does not explain what, if anything, is expressive about these hierarchies, and I reserve rights to respond to Cisco's contentions in this regard.

530. As Cisco has described the asserted CLI command hierarchies, they are not expressive, but are merely methods of operation and systems for organizing commands in an extensible manner, for the functional purpose of ensuring consistency and usability of the CLI. As Cisco's corporate witness, Mr. Remaker, explained:

Q. … [W]hy is extensibility important to creating a

[102] 1/5/2016 7th Supp. Resp. to 1st Ints. at 15.

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> new CLI command in Cisco IOS? …
>
> **THE WITNESS**: We believe that the hierarchy improves the consistency, usability and friendliness of the CLI. ...
>
> **Q**. What does a hierarchy have to do with extensibility of the CLI? ...
>
> **THE WITNESS**: The hierarchy keeps similar and related commands together with each other.
>
> **Q**. How does the hierarchy keep similar and related commands together with each other? …
>
> **THE WITNESS**: For example, in a hierarchy, the command line help function will direct customers to the related commands to the tasks they're trying to accomplish instead of having to wade through unrelated commands.

Cisco Corp. Dep. Tr. ("Remaker") at 53-54.

531. Similarly, the claimed "author" of the hierarchies--Kirk Lougheed--explained them as follows: "developing a hierarchy is a way of managing complex entities that have many similarities and a few differences." Lougheed Dep. Tr. at 158.

532. In other words, the asserted command hierarchies are simply a system of "keep[ing] similar and related commands together with each other" so that the CLI help functionality can "direct customers to the related commands to the tasks they're trying to accomplish instead of having to wade through unrelated commands." Cisco Corp. Dep.

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Tr. (Remaker) at 53-54.

533. The hierarchy also serves as a system for allowing additional commands to be added within existing groupings. Mr. Lougheed, who Cisco credits as the creator of the asserted "command hierarchies," testified that "the benefit of th[e] framework of the hierarchy" was "allowing for implementing new functionality in a … logical, correct place." Lougheed Dep. Tr. at 148-149. Indeed, this system of organizing commands as part of a "hierarchy" grew out of necessity for implementing a system to identify what routing protocol a particular CLI command (or family of CLI commands) would configure or impact where the networking device supported multiple protocols. *Id.* at 129-130 (describing that the use of the "ip" command keyword to preface "IP-only commands" arose because the networking device supported not only "ip" but also DECnet and other protocols).

534. As Mr. Lougheed put it, in the context of providing a usable CLI to an end user,"[w]hen one is talking about different networking protocols, ***one needs to clarify which networking protocol one is talking about.***" Lougheed Dep. Tr. at 131. The use of a command hierarchy is a system for performing that function--namely, identifying to the user the specific networking protocol on which a particular command will operate. In other words, as Mr. Lougheed explained it, "developing a hierarchy is a way of managing complex entities that have many similarities and a few differences." *Id.* at 157-158; *see also* 159 (characterizing the command hierarchy as an "abstract concept").

535. The claimed Cisco hierarchies appear to be simply grouping commands under a common feature, represented by the first word in the command. For example, commands related to "Authentication, Authorization and Accounting" are grouped under

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a first command word of "aaa". Commands related to the IP protocol start with "ip" and for the ipv6 protocol start with "ipv6". To point to any asserted "hierarchy" is to say nothing more than that related functions are selected by starting with a common keyword. And the selection of functions within a particular "hierarchy" is, necessarily, a reflection of the underlying functionality. Furthermore, as noted below, the vast majority of these common keywords are, themselves, not original to Cisco but rather reflect common industry terms. The "IP" hierarchy reflects various commands beginning with that word which indicate functions that are related to the "IP" protocol, as opposed to other protocols. As such, in my opinion there is nothing about Cisco's hierarchy claim that is anything other than a system or method of operation of grouping related functions. To suggest that Cisco has a copyright in, for example, the IP hierarchy, would suggest that only one vendor can organize commands by various industry-wide protocols or specifications.

536. The modes that Cisco identify as copied protected expression, and the corresponding prompts that indicate the respective modes,[103] are another aspect of the overall method of operation of accessing functionality of the network device on which the software is running. Specifically, the asserted CLI command modes and prompts are part of a system for organizing command sets into different categories. Command modes, by definition, operate by separating command sets into different "buckets" such that the various CLI commands that a user can run (and are recognized by the CLI parser as a valid command) will be contingent upon the particular CLI command mode that the user is in.

[103] *See, e.g.*, 8/7/2015 Exh. C to 1st Supp. Resp. to Int. 2.

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537. As Mr. Lougheed, who Cisco credits as the originator of the accused command modes and prompts, testified at his deposition, "when you have multiple devices on a network, ***one of the things you want to know if you're typing at something is … what you are typing at***." Lougheed Dep. Tr. at 111 (explaining why the command prompt includes the name of the device that you are configuring). That purely utilitarian functionality--providing descriptive information to the user about what networking device you are actually configuring or querying with the commands being entered into a CLI--is a system or a method of operation.

538. The idea that a command prompt on a networking device CLI must inform the user what device, protocol, or interface is being affected by the command being entered (*i.e.*, what exactly the user is configuring, or querying for information) is one shared by all networking vendors analyzed in this Report. The fact that all vendors implement this idea in essentially the same way is a strong indication that the use of command prompts is a system or method of operation. A "mode" is simply an indication of the internal state of the parser indicating what method within the parser should be applied to text the user enters. It is not clear what expression Cisco could claim in the asserted "modes," but I reserve the right to respond after reviewing Cisco's opening report.

539. To the extent Cisco identifies certain excerpts of command responses as copied protected expression,[104] those excerpts are also part of a system or method of operation. Command responses are screen displays typically provided to inform a network administrator of the status of the device or the network. The identified excerpts

[104] *See, e.g.*, 9/1/2015 Exh. E to 2nd Supp. Resp. to Int. 2.

of allegedly copied protected expression are subsets of these screen displays--sometimes a phrase or a single line of text, sometimes a series of abbreviations, sometimes a series of data headings, etc. In all cases, however, the excerpts are part of an overall system or method of operation, namely obtaining and organizing data regarding state.

540. Consider for example the list of abbreviations for which Cisco claims copyright protection.[105] This is a purely functional recitation of common industry protocols or terms associated with those protocols. Such a list uses the first word of the term(s) as abbreviations for the standard term. Neither the standard term, nor the idea of abbreviating the term, nor using the first letter for the abbreviation, is anything more than a system for coding the "show ip route" status.[106]

541. Consider also, for example, Cisco's claim of copyright infringement based upon the similarity of parameters identified in response to the "show snmp" command.[107] SNMP is a standardized protocol, and I understand that Cisco is not claiming any proprietary rights in SNMP in particular. The parameters listed here are functional elements available in an SNMP implementation. These short descriptions of the parameters are purely functional. These descriptions are inseparable from the underlying system that allows for the tracking of each such metric. Moreover, it would be be expected that customer scripts would seek these descriptions in order to programmatically read the state of the SNMP operations. In this way, the allegedly copied descriptions form a systematic roadmap for scripts to determine the state of the switch automatically by relying on these expected identifiers of different metrics and

[105] *Id.* at 1.
[106] I note also that Arista has not used similar abbreviations for features it does not use, such as Cisco's proprietary EIGRP protocol.
[107] *Id.* at 2.

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data.

542. Finally, consider as another example the headings for "show port-security" in which Cisco claims copyright.[108] Again, these headings represent a system of organizing and reciting network status information. These headings are similar to a blank form. By using these headings to display network state data, Arista assures that such data appears in the columns expected by network administrators, as one might expect a certain layout for the standings table of a sports league or the layout of contact information for a phone list. Additionally, as with the SNMP parameters, these headings are the type of screen displays that would likely be used by network scripts to locate automatically relevant state information.

B. The Asserted Aspects of the Cisco CLI Lack Originality

1. The Asserted CLI Commands are not original.

543. Based on my analysis below and in this Report, it is my opinion that the asserted CLI commands consist primarily of terms taken from (and defined and used in) published industry standards from standards setting bodies like the IETF and IEEE, from documents like Informational RFCs that describe *de facto* industry practices or industry best practices, and/or widely and commonly used industry terms relating to the CLI command's functionality. As described below, and based on my review of deposition testimony (in particular, the testimony of Cisco engineers Tong Liu, Devadas Patil, Anthony Li, Kirk Lougheed, Abhay Roy, Ram Kavasseri, and Pradeep Kathail) and documents produced in this lawsuit, the individuals responsible for adding new CLI commands to a Cisco product are typically very familiar with, have access to, and

[108] *Id.*

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directly consult any industry standards (for example, IETF RFCs and IEEE standards) that might relate to those commands before such commands are added to Cisco's CLIs. Those individuals, based on their education and training leading up to their roles as Cisco engineers, are also typically familiar with widely used networking terminology before they add any new CLI commands to Cisco's CLIs.

544. A summary of the relevant IETF and IEEE standards and related documents (including non-Standards Track RFCs and Internet Drafts that describe *de facto* industry standard practices and protocols) is attached to this Report as **Appendices A and B**. Those appendices identify the many IETF and IEEE documents that describe, define, and use many of the command keywords found within the asserted CLI commands (and command fragments), and also discuss several common command keywords widely used in the industry. **Appendices E** through **H** also highlight the widely used and familiar CLI commands and keywords that are known to and used by many vendors in the networking industry.

545. It is also my opinion that several of the asserted CLI commands, and aspects of their syntax, were copied from networking systems and products that predated the addition of those CLI commands (or CLI syntax conventions) to Cisco's CLIs. Based on my review of deposition testimony and documents produced in this lawsuit, many aspects of the asserted CLI commands--and some entire commands--were taken from Digital Equipment Corporation (DEC) products, including DECSYSTEM-20, TOPS-20, and DEC VAX/VMS products. Cisco admits Cisco viewed DEC's CLI as a "defacto industry standard" and copied "some of the common commands".[109]

[109] Email from Nicholas Thille to Robert Snyder, 11-May-1994 [CSI-CLI-04978736]

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546. Moreover, as described below, those systems--and other legacy systems including UNIX, MS-DOS, and others--featured CLIs with many of the same basic features and functionality (including command modes and prompts) that Cisco asserts in this lawsuit. Based on my review of deposition transcripts and documents produced in this lawsuit, several Cisco engineers responsible for adding those features to the Cisco IOS CLI had access to, and were already familiar with, the same or similar features in DEC, UNIX, and other legacy systems.

2. Asserted aspects of the Cisco CLI came from prior legacy systems, and did not originate from Cisco.

547. Based on my analysis below and in this Report, it is my opinion that several fundamental aspects of the IOS CLI that Cisco is asserting against Arista were copied and taken directly from other CLIs that existed in non-Cisco systems and software.

548. Many features of the Cisco IOS CLI, including features that Cisco asserts copyright over in this lawsuit, originated from a non-Cisco operating system called TOPS-20. TOPS-20 was not developed by Cisco, but was instead developed by a company called Digital Equipment Corporation, or DEC. *See, e.g.*, Lougheed Dep. Tr. at 43; *see also* ARISTANDCA00038298 (TOPS-20 Commands Reference Manual, AA-FP65A-TM, Sept. 1985);

549. TOPS-20 was the operating system for DEC equipment, including the DECSYSTEM-20, which have been in use since the 1970s, as confirmed by Kirk Lougheed, who worked on DECSYSTEM-20 systems in the early 1980s before he began any work on the software that would become the Cisco IOS software. *Id.* at 33, 43.

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550. For example, TOPS-20 supported different modes where a given user had different privileges and capabilities. *See, e.g.*, Lougheed Dep. Tr. at 256-259. As Mr. Lougheed confirmed at his deposition, TOPS-20 had a "human interface" program called EXEC, similar to the "User EXEC" command mode that is used in Cisco IOS and in almost all CLIs used in the networking industry today. *Id.* at 50-51 ("**Q.** Are you familiar with something called EXEC, E-X-E-C, in TOPS-20? **A.** Yes **Q.** What is that? **A.** It's a program. **Q.** What does it do? **A.** It's the interface -- the human interface for the TOPS-20 operating system. … **Q.** Was the EXEC program part of TOPS-20? **A.** Yes."); *see also id.* at 381-382 (confirming that "Exec" and "User EXEC" refer to the same command mode); *see also* ARISTANDCA00038298 at Page Intro-9 (TOPS-20 Commands Reference Manual, AA-FP65A-TM, Sept. 1985) (discussing the "EXEC" TOPS-20 Command Processor).

551. In addition to the EXEC, TOPS-20 had a "privileged" mode. *See, e.g.*, Lougheed Dep. Tr. at 55-56 ("**Q.** Do you understand whether there was a privileged mode in TOPS-20? **A.** Yes. There is -- there is a privileged mode. **…** **Q.** Did privileged mode allow you a different set of commands than in a non-privileged mode? **A.** There were a -- yes."). Like Cisco IOS and the many different CLIs I analyze in this Report, TOPS-20 indicated to the user that they were in different modes by changing the command prompt. *Id.*

552. To get into "privileged" mode (as Mr. Lougheed characterized it) in TOPS-20, the user would enter the command "enable" to access that mode. Lougheed Dep. Tr. at 56; ARISTANDCA00038298 at Page 137 (TOPS-20 Commands Reference Manual, AA-FP65A-TM, Sept. 1985) (discussing the "enable" command).

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553. This standard CLI functionality used in TOPS-20--entering the "enable" command to move from "User EXEC" mode to "PRIVILEGED EXEC" mode--is also present in most of the CLIs from the various networking vendors analyzed in this Report, including in the Cisco IOS CLI. *See*, *e.g.*, CSI-CLI-00024968 (Cisco Configuration Fundamentals, Config. Guide, Cisco IOS Release 15.2T) (showing that entering "enable" at the User EXEC command prompt "[e]nables privileged EXEC mode").[110]

554. This separation of different users (or accounts) with different system privileges is also found in legacy UNIX systems that pre-date Cisco IOS. Those UNIX systems feature a "root user" or "superuser" that had more privileges than other accounts. *Id.* Importantly, most UNIX system implementations use the command prompt "#" to indicate that the root user account is logged in. This is equivalent to the "#" prompt used in the privileged mode of the Stanford SUMEX CLI, the "#" prompt used for the privileged mode in the Stanford EECF software CLI, and the "#" prompt used for privileged EXEC modes used in almost all of the switch and router CLIs analyzed in this Report.

555. UNIX also supported a "clear" command, as Mr. Lougheed admitted at his deposition. See Lougheed Dep. Tr. at 173-174. While Mr. Lougheed testified that the "clear" command in UNIX was not used "in the sense that the Cisco CLI uses 'clear'" in its CLI commands, I note that some of the Arista CLI commands that Cisco accuses in this lawsuit are similarly not used in the same way that the Cisco CLI uses them (*e.g.*, "ip

[110] Elsewhere in this Report I discuss the various command modes supported by many different vendors in the networking industry. On those same cited pages, most of the vendors use the "enable" command to move from a non-privileged command mode to a privileged command mode. *See, e.g.*, 19006JNPR00130657 at Page 194 (Juniper JUNOEs Internet Software - Command Reference A-M 7.1x) ("From User Exec mode, [the 'enable' command] enters Privileged Exec mode at the specified privilege level."); HPE44508 at Page 29 (HP Basic Operation Guide, 2013) (describing the "enable" command to enter a privileged "Manager" mode).

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protocol" and "max-connections," which are used for the "Monitor Reachability" and LANZ features found only in Arista switches). Moreover, using "clear" as a command long predates its use in Lougheed's work: I used to type "clear" on my TRS-80 as early as 1978 when I wanted to erase variables from memory[111].

556. TOPS-20 also supported the use of several common CLI features discussed throughout this report. For example, the TOPS-20 CLI supported command abbreviations being entered into the CLI, just like almost every other CLI analyzed in this Report. *See* ARISTANDCA00038298 at Page Intro-5 (TOPS-20 Commands Reference Manual, AA-FP65A-TM, Sept. 1985) (discussing the "abbreviation" feature where "[t]he smallest unique abbreviation for a command or argument will stand for the entire word"). TOPS-20 also supported command completion, where it would automatically complete an abbreviated command word when the user hit a particular key (ESC in the case of TOPS-20). *Id.* at INTRO-6; *see also* ARISTANDCA00009216 at Section 1.1, Table 1-1 (TOPS-20 User's Guide, 1988) (discussion command completion functionality).

557. And TOPS-20 also supported a context-sensitive help system triggered by the use of a question mark "?" character in the CLI, just like almost every other CLI analyzed in this Report. *See* ARISTANDCA00038298 at Page Intro-6 (TOPS-20 Commands Reference Manual, AA-FP65A-TM, Sept. 1985) ("Whenever you type a question mark (?) instead of (or even in the middle of) a TOPS-20 command or command argument, the system responds with instructions or a list of possible completions. By using questions marks and recognition when you are unsure of the proper command or argument, you can have the system help you during your terminal session.").

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[111] See for example, the TRS-80 manual at http://www.classiccmp.org/dunfield/kyocera/m100qr.pdf

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558. Former Cisco employee Anthony Li confirmed these features of TOPS-20 in his deposition: "TOPS-20 had a command syntax that was somewhat similar to [DEC VAX] VMS [discussed further below]. The notable difference was that TOPS-20 allowed for a command completion, and so you could use escape and tab and question mark characters to interact directly with the command line interpreter while you were typing a command line." Li Dep. Tr. at 21-24 (discussing his use of TOPS-20 in 1982, before Cisco was created and confirming his "hands-on" experience with TOPS-20).

559. Former Cisco employee Gregory Satz also testified about the similarities between TOPS-20 and the Cisco IOS CLI. For example, Mr. Satz confirmed that the Stanford TIP (Terminal Interface Processor) software upon which the Cisco IOS software was based "mimicked the TOPS-20 style of parsing, and it -- there were commands that people would use to just have the device do what it does day-to-day, and there were commands that administrators or users who needed to maintain the device in the network would use. And so privilege commands were the latter set, and TOPS-20 had a very similar model." Satz Dep. Tr. at 26-30; *see also id.* at 47-49 (discussing the EXEC mode in TOPS-20 the use of an "enable' command to enter a privileged mode). And Mr. Satz also confirmed that the use of "show" commands was not unique or original to Cisco:

> **Q.** Had you ever heard of or used show commands in
> any context before you went to Cisco?
> **A.** Every computer has show commands. I mean every
> operating system had used the word "show" as a way
> to convey internal information outward.

Id. at 32; *see also* ARISTANDCA13228395 (TOPS-20 DECnet-20 Programmer's Guide

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and Operations Manual AA-50918-TM Jan. 1980) (listing "show" and "set" commands as part of the Network Control Program, or NCP, commands).

560. DEC also developed an operating system for its VAX line of products called VMS. VAX means virtual address extension and VMS is virtual memory system. *See* Anthony Li Dep. Tr. at 17-21 (discussing his experience with the DECnet network at USC in the 1980s and DEC VAX/VMS operating system, and noting that his first exposure to VAX/VMW was in 1981, before Cisco was created). Like TOPS-20, the VAX/VMW operating system had a command line interface, and used commands like "SHOW" and "SET". *Id.* at 20. As former Cisco employee Anthony Li explained at his deposition, the VAX/VMS operating system--which predated Cisco IOS--was a "very standard command-and-response interface." *Id.*; *see also* ARISTANDCA13228395 (TOPS-20 DECnet-20 Programmer's Guide and Operations Manual AA-50918-TM Jan. 1980) (listing "show" and "set" commands as part of the Network Control Program, or NCP, commands).

561. As Mr. Li further explained, the entire operating system CLI for DEC VAX/VMS was built around DCL, or Digital Command Language. Li Dep. Tr. at 21. The "show" commands supported by DEC VAX/VMS as early as 1981 followed a hierarchical command syntax very similar to the "show" commands disputed in this lawsuit:

> **Q.** Did the show commands in VAX/VMS follow any particular syntax?
>
> **A.** Yes. They typically were invoked by show and then usually an object name and then a set of parameters.

… The set commands were pretty much the same way.

Id. at 21-22. Mr. Li's description of the DEC VAX/VMS command syntax, particularly with respect to "show" and "set" commands, is consistent with my experience using VAX/VMS, as well as the command reference manuals describing the VAX/VMS commands. *See* ARISTANDCA13229400 (VAX/VMS Primer Order No. AA-0030C-TE May 1982).

562. Indeed, the VAX/VMS manual also confirms that its CLI supported the widely used command abbreviation functionality, in addition to "show" and "set" commands:

> **1.4.2 Abbreviating Commands**
>
> When you type commands, qualifiers, or parameters you do not always need to type the full word. In fact, you never have to type more than the first four characters, and in many cases you can type only one or two characters. The rule to follow is: you must type at least the minimum number of characters necessary to make the command unique.
>
> For example, the SET, SEARCH, and SHOW commands all begin with the letter "S." To make the SHOW command unique, you must type at least two characters, SH. To make the SET and SEARCH commands unique, you must type three characters, SET and SEA respectively.
>
> The examples in this primer show full commands so that you can become familiar with the commands and what they do.

See ARISTANDCA13229400 at Page 1-6 (VAX/VMS Primer Order No. AA-0030C-TE May 1982).

563. DEC also developed what it called its DECnet Digital Network Architecture, which was released in several phrases. DECnet Phase III was released in 1980, well before Cisco existed. *See* ARISTANDCA13228703 (DECnet DIGITAL Network Architecture (Phase III) Network Management Functional Specification Order No. AA-K181 A-TK Version 2.0.0 October 1980). Phase IV was released in 1983, also before Cisco was created. *See* ARISTANDCA13229492 (DECnet Digital Network

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Architecture Phase IV Network Management Functional Specification Order No. AA-X437A-TK Dec. 1983). Phase V was released in 1987. *See* KL-00000251 (DECnet DIGITAL Network Architecture (Phase V) General Description Order No. EK-DNAPV-GD Sept. 1987, produced from Kirk Lougheed's personal files); *see also* Lougheed Dep. Tr. at 244-245 (authenticating and discussing the DECnet Phase V document).

564. The DECnet Digital Network Architecture, at least as of 1980, featured a Network Control Program (NCP) that used a CLI with a multi-word command syntax very similar to those at issue in this case:

```
All NCP commands have the following common syntax:

command  entity  parameter-option(s)

where:

command                  Specifies the operation to be performed, such
                         as SHOW or LOAD.

entity                   Specifies the entity (component) to which the
                         operation applies, such as LINE or KNOWN
                         NODES.

parameter-               Qualifies the command by providing further
option(s)                specific information.
```

ARISTANDCA13228703 at Page 15 (DECnet DIGITAL Network Architecture (Phase III) Network Management Functional Specification Order No. AA-K181 A-TK Version 2.0.0 October 1980).

565. The NCP CLI, at least as of 1980, also supported "clear" and "show" commands:

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3.3.2 **CLEAR and PURGE Commands** - These commands clear parameters from the volatile and permanent data bases. The CLEAR command affects the volatile data base; the PURGE command affects the permanent data base. Not all parameters can be cleared individually. A cleared or purged parameter or entity identification is the same as one that has not been set or defined. The general form of the command is:

$$\begin{Bmatrix} \text{CLEAR} \\ \text{PURGE} \end{Bmatrix} \text{ entity parameter}$$

The entities are the same as for the SET and DEFINE commands (Section 3.3.1).

3.3.8 **SHOW and LIST Commands** - These commands are used to display information. The SHOW command displays information from the volatile data base. The LIST command displays information from the permanent data base. The general command format is either:

$$\begin{Bmatrix} \text{SHOW} \\ \text{LIST} \end{Bmatrix} \text{ entity [information-type] [qualifiers]}$$

or:

$$\begin{Bmatrix} \text{SHOW} \\ \text{LIST} \end{Bmatrix} \text{ [information-type] entity [qualifiers]}$$

ARISTANDCA13228703 at Pages 29-35 (DECnet DIGITAL Network Architecture (Phase III) Network Management Functional Specification Order No. AA-K181 A-TK Version 2.0.0 October 1980).

566. This DECnet NCP CLI command format persistent in Phase IV as well:

The interactive user manages the network mainly by entering commands of the form:

verb entity entity-option

The verb is an English verb such as SET, CLEAR, SHOW, LOAD, or LOOP.

See ARISTANDCA13229492 at Page 15 (DECnet Digital Network Architecture Phase IV Network Management Functional Specification Order No. AA-X437A-TK Dec. 1983).

567. Finally, DEC also released DECnet-RSX, which refers to multiple

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DECnet products. *See* ARISTANDCA13230687 (DECnet-RSX Guide to Network Management Utilities Order No. AA-EB30A-TC September 1985) (listing those products on Page Preface-1). The networking management utilities for the DECnet-RSX products also supported CLI commands that followed the familiar "verb component(s) parameter(s)" format, and specifically supported "clear" and "show" commands:

Command Verbs	Components	Parameter Lists
CLEAR	EXECUTOR	HOST RECEIVE PASSWORD TRANSMIT PASSWORD
CLEAR	{ LINE *line-id* / KNOWN LINES }	{ ALL / COUNTER TIMER }

Id. at pp. 1-6; *see also id.* at pp. 1-166 to 1-171 (showing the syntax for six different "show" commands, including "show line," "show system," and others).

568. Cisco's own documents acknowledge the Cisco IOS CLI's roots in these early DEC systems. For example, in an email discussion between Cisco employees regarding the context-sensitive help system in Cisco IOS, Cisco employee Aaron Leonard commented: "I've been using the '?' since TOPS-20 version 4 (20+ years ago), so at this point I'm probably neurologically incapable of doing anything else." *See* CSI-CLI-00810004 (Cisco email dated Nov. 16, 2005).

569. Another Cisco document from May 1994 similarly acknowledges:

> DEC has popularlized the terminal server, and the command interface used on their terminal servers has become a defacto industry standard. cisco's user interface is different, although some of the common commands are the same. In 9.1, we implement additional popular commands that match the DEC syntax.

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CSI-CLI-04978736.

570. Anthony Li, who worked at Cisco for many years, also testified that [redacted] Mr. Li further explained, [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

571. Several disputed commands, like “show users” and “terminal length,” were also supported by legacy DEC products. *See* ARISTANDCA00036076 at Page 20 (DECServer 2000 User Guide, showing support of “show users”); ARISTANDCA00038298 at Page 366 (TOPS-20 User Manual, showing support of the“terminal length” command).

572. The command keyword “enable” was also supported by DEC TOPS-20 before it was used in Cisco IOS. *See* ARISTANDCA00038298 at Page 137 (TOPS-20 User Manual, showing support of the “enable” command keyword to “activate[] capabilities”).

573. MS-DOS was another operating system that pre-dated Cisco IOS in the early 1980s, and was known to early Cisco engineers. It too featured a command-line interface, and had a user prompt with the “>” (closed angle bracket) character. *See, e.g.*, Lougheed Dep. Tr. at 121.

574. There were also print controlling programs that existed before the Cisco IOS CLI was built, including the Quasar print controlling program, which was used in the EECF department at Stanford when Mr. Lougheed worked there in the early 1980s before he became an employee at Cisco. *See* Lougheed Dep. Tr. at 260. Quasar had a user interface program called OPR, which had a CLI. *Id.*[112] That CLI used commands that started with the first word “show,” such as “show route-table.” *Id.*; *see also* KL-

[112] As Mr. Lougheed noted at his deposition, in the early 1980s, there were no Graphical User Interfaces available, and therefore every system used a CLI. *See* Lougheed Dep. Tr. at 260.

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00001699 (email from Mr. Lougheed's files showing his personal use of a Quasar OPR CLI "show" command).

575. I understand that Cisco, in its discovery responses, claims that Mr. Lougheed is the original "author" of the disputed command modes, associated prompts, and command hierarchies in the Cisco IOS CLI. *See* Cisco's Responses to Interrogatory Nos. 5 and 16. I further understand that Cisco claims that Mr. Lougheed is the "author" of several of the asserted CLI commands . *See* Exhibit F to Cisco's Responses to Arista's Interrogatories (including all supplements to Exhibit F).

576. Mr. Lougheed admitted at his deposition, when presented with his Stanford EECF (Electrical Engineering Computer Facility) employee personnel files and his own representations of his purported technical qualifications in his resume and job applications, that he was already experienced with the Digital Equipment Corporation TOPS-20 operating system as of 1980, and DECSYSTEM-20 mainframes (including DECSYSTEM-2060 systems) as of 1983. *See, e.g.*, Lougheed Dep. Tr. at 212-222 and exhibits discussed therein; KL-00000872. The DECSYSTEM-20 mainframes that Mr. Lougheed worked with at Stanford ran the TOPS-20 operating system. Lougheed Dep. Tr. at 226.

577. Indeed, Mr. Lougheed was so familiar with TOPS-20 as of 1983 that he served as the Stanford contact with DEC for field testing of new releases of the TOPS-20 operating system. Lougheed Dep. Tr. at 226. He also had TOPS-20 user documentation in his possession while an employee at Stanford, and before he began working at Cisco. *Id.* at 242-243 and associated exhibits (admitting that he had possession while at Stanford of TOPS-20 user documentation beyond the manuals he produced in this lawsuit).

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578. Mr. Lougheed's extensive experience with the TOPS-20 CLI functionality influenced the CLI functionality he purportedly added to the Cisco IOS software. For example, Mr. Lougheed admitted at his deposition that the choice of an "EXEC" command mode in Cisco IOS was "inspired by the TOPS-20 command processor" and was therefore not his original creation. *See* Lougheed Dep. Tr. at 109. And he further admitted that calling a command mode "privileged" did not originate with Cisco. *Id.* at 112 ("**Q.** Did Cisco come up with the nomenclature of calling a mode 'privileged', to your knowledge? **A.** I don't believe — I don't believe Cisco came up with that terminology. "). He also admits that he "adopted" the convention of using a "percent sign leading a message [to] indicate[] that you are looking at an error message" directly from TOPS-20. *Id.* at 123-124; *see also* CSI-ANI-00043306 (Mr. Lougheed's email containing that admission).

579. Mr. Lougheed also confirmed at his deposition that his Stanford EECF team had full responsibility for multiple Digital Equipment Corporation VAX-11/780 and VAX-11/750 super-minicomputers and minicomputers, and that at least one member of his team, including Mr. Gregory Satz (who was also deposed in this lawsuit and an early employee at Cisco), worked directly with those Stanford EECF VAX systems. *See, e.g.*, Lougheed Dep. Tr. at 222-224. As confirmed by Mr. Lougheed, the DEC VAX systems used by the Stanford EECF department as of 1983 ran operating systems called VAX/VMS and Berkeley UNIX. *Id.* at 224.

580. In addition to the foregoing systems, as discussed above in the section of this Report addressing the origins of Cisco's routing software in Stanford EECF and SUMEX source code, several features and functionality of the Cisco IOS CLI were also

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copied by Mr. Lougheed from routing systems developed at Stanford and written by Stanford employees including William Yeager. Specifically, [redacted]

581. Moreover, Mr. Lougheed confirmed in his deposition that he was already familiar with the use of "show" commands in non-Cisco systems that predated the Cisco IOS. For example, Mr. Lougheed testified that the Quasar print controlling program at Stanford used "show" commands in its OPR CLI, and that he had to use the Quasar OPR CLI a lot to fix the printers at Stanford. *See* Lougheed Dep. Tr. at 260; KL-00001699. Mr. Lougheed had therefore already used "show" commands frequently as a Stanford employee on the Quasar system. Finally Mr. Lougheed admitted at his deposition that he was aware that MS-DOS, which was released in the early 1980s before Cisco existed, used a ">" character as a command prompt. *See, e.g.*, Lougheed Dep. Tr. at 121.

582. In sum, Cisco engineers responsible for creating the Cisco IOS routing software were well aware of and had experience with legacy CLI functionality, and copied those features when creating the Cisco IOS CLI.

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3. Terms used in the accused CLI commands come directly from industry standards, and well-known, descriptive industry parlance.

583. Based on my review of the asserted commands, the relevant industry standards and industry publications (many of which are discussed in detail in **Appendices A and B**), and my knowledge and expertise in the networking industry, it is my opinion that the vast majority of terms used in the accused CLI commands come directly from industry standards, and well-known descriptive industry parlance.

584. As discussed in **Appendices A and B**,which I incorporate into this section of my Report, the vast majority of command keywords used in the asserted CLI commands (and command fragments) are found in, defined by, and used throughout industry publications and standards from standards-setting bodies like the IETF and the IEEE. These publications are frequently the product of multiple vendors (typically part of a subject-specific Working Group) contributing ideas and collaborating for the sake of promoting interoperability between networking devices. The use in CLI commands of terminology found in those IETF and IEEE standards and publications that relate specifically to the functionality provided by each such command is expected and important to users of networking equipment CLIs.

585. For example, former Cisco employee Tony Li, who also worked for several competitors of Cisco including Juniper Networks and Procket Networks, made clear at his deposition that standardization is important to the networking industry, and that the use of industry standard-terminology was important to the development of Cisco CLI commands, simply because it minimized confusion:

> **Q.** Mr. Li, do you believe standardization is important

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> to the networking industry?
>
> **A.** Extremely important. Without standardization we do not get to interoperability; without interoperability, we don't have a network.
>
> **Q.** To what extent, if at all, was the use of industry-standard terminology encouraged in Cisco's command sets?
>
> **THE WITNESS:** So the use of industry-standard terminology was encouraged largely by the engineering community of which much of Cisco's development was driven by simply because it minimized confusion.

Li Dep. Tr. at 129-130.

586. Moreover, the use of industry-standard terms and phrases in CLI commands stems directly from the fact that engineers adding such commands typically reviewed the applicable IETF and/or IEEE standards and publications to familiarize themselves with both the functionality and terminology associated with the command. Several Cisco witnesses testified regarding the development procedures they followed at Cisco when new CLI commands and networking functionality were added to the Cisco IOS CLI (including NX-OS and other flavors of Cisco IOS in dispute).

587. For example, former Cisco engineer Tong Liu--who Cisco identified as the author of several CLI commands relating to industry-standard PTP (Precision Time Protocol) functionality--testified that she reviewed the IEEE PTP industry standard from

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cover to cover at the start of the development process, and consulted those standards when adding new CLI commands to Cisco IOS:

> **Q**. When was the first time that you saw the IEEE PTP standard?
>
> **A.** That's when I was working on this industrial Ethernet switch development around 2008, I think. …
>
> **Q**. … So did you see the IEEE PTP standard before you began adding PTP functionality to the Cisco industrial Ethernet switch?
>
> **A.** When you say "before." it's before I started writing code?
>
> **Q.** Yes.
>
> **A**. I — yes, I read the spec … — for understanding — to understand how it works. …
>
> **Q.** And did you read the entire standard before you began working on the PTP functionality?
>
> **A.** Yeah, I believe I read the -- the entire -- or the majority part of it.
>
> **Q.** That's -- that's impressive. How -- the standard is -- is several hundred pages long. But you read the whole thing -- you remember reading the whole thing?
>
> **A.** Yes.

Liu Dep Tr. at 94-97; Ex. 93 (IEEE Standard 1588-2008, Precision Time Protocol,

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ARISTANDCA00031733).

588. Ms. Liu also confirmed that she consulted the IEEE 1588-2008 PTP standard while she was coding the PTP functionality for Cisco's switches because "[a]ll of the messages format, the field definitions behaviors, are documented here [in the standard]." Liu Dep. Tr. at 97. She also confirmed that the PTP IEEE standard defines terms and acronyms, as well as functionality, that she ultimately implemented in Cisco switches. *Id.* at 105-118 (also confirming that the defined acronym "ptp" in the IEEE standard refers to the same "ptp" command keyword in the disputed PTP-related CLI commands, that the standard defines and uses PTP-relevant terms like "clock," "parent clock," "parent," and that certain mandatory parameters like "priority 1" and "priority 2" are defined by the IEEE standard); *id.* at 121-122 (providing similar testimony regarding the PTP standard's use and definition of "sync interval").

589. The disputed CLI commands she added to the Cisco IOS CLI include industry-standard acronyms and terms that are expressly defined by the IEEE industry standard. This includes "ptp" as the defined acronym for "Precision Time Protocol" and several "mandatory" (in the IEEE standards documents, a "MUST" support feature required for compliance with the standard) parameters and attributes for PTP, including the "priority1" and "priority2" parameters. When asked about the meaning of the terms in her various PTP commands, Ms. Liu confirmed at deposition that they meant that same thing--and were intended to carry the same meaning--as the corresponding terms in the IEEE PTP standard 1588-8000:

> **Q.** Now, does the priority 1 parameter in the CLI
>
> command "PTP priority 1," does that refer to the

priority 1 attribute in the IEEE standard marked as Exhibit 93?

… **THE WITNESS:** Yes. I think I chose it for the intention to mean the priority 1 attribute of the clock.

… **Q.** And is your answer the same for the command "PTP priority 2"? Is the priority 2 command parameter -- does that refer to the priority 2 attribute in the IEEE standard marked as Exhibit 93?

… **THE WITNESS:** It's referring to the same - that attribute, yes.

Q. That attribute in the IEEE standard?

A. In the IEEE standard, yes.

Q. **…** And you knew about the priority 1 and priority 2 attributes in the IEEE standard before you started adding the "PTP priority 1" and "PTP priority 2" commands to the iOS software; correct?

A. Yes, I read the spec.

Q. And you were aware of those two particular attributes before you started adding the "PTP priority 1" and "PTP priority 2" commands to Cisco's routing software; right?

A. Yes

See, *e.g.*, Liu Dep. Tr. at 137-141, 146-148 (providing similar testimony for these and

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other PTP command words like "sync interval"); 153-156 (same testimony for the PTP term "clock" and "parent" in the PTP-related CLI commands).

590. Former Cisco engineer Devadas Patil provided similar testimony at his deposition. Mr. Patil, who Cisco identified as the "author" of several CLI commands relating to LLDP (Link Layer Discovery Protocol, an industry standard protocol defined by the IETF), described in detail a multi-stage process for the development of new Cisco IOS functionality where the review and analysis of any related industry standards precede the addition of new Cisco IOS CLI commands. Patil Dep. Tr. at 80-82 (testifying that new CLI commands and the syntax for them are part of Stage 3 of a five stage process); 115-117 (confirming that LLDP is a ratified industry standard, that he had no role in its standardization, but that as soon as he was tasked with the LLDP project in late 2005, he "researched it actively and wanted to know as much of it as possible as early as possible.").

591. Mr. Patil explained that the development process for implementing LLDP in the Cisco IOS software proceeded in stages: (1) market analysis/requirements gathering; (2) architecture; (3) design; (4) implementation; and (5) testing. Patil Dep. Tr. at 70-71, 124-125. As part of that development process, he looked at other vendors' offerings in the LLDP space (as part of Stage 1), including discussions with HP about their ProCurve implementations of the LLDP industry standard. *Id.* at 72-78.

592. Critically, Mr. Patil also confirmed that he reviewed the IEEE standards documents (802.1AB) for LLDP in the 2005 time period as part of "Phase 1" of the multi-stage development process. Patil Dep. Tr. at 116-120 (confirming that Ex. 315 at his deposition was the IEEE standard for "802.1AB, which is the technical name for

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LLDP"); Ex. 315 (IEEE Standard 802.1AB) (ARISTANDCA00017907). He further testified that he made a "full attempt" to review the IEEE LLDP standard from front to back in order to do "a very solid job of the architecture." *Id.* at 130-131. This is because Cisco's implementation of LLDP, unsurprisingly, was based on the 802.1AB standard. *Id.* at 144-145.

593. Mr. Patil also confirmed that several terms used in the LLDP commands were widely used in the LLDP standard, such as TLV. Patil Dep. Tr. at 76. Indeed, Mr. Patil readily admitted that he had become familiar with, or was already familiar with, many terms and acronyms defined or used in the IEEE 802.1AB (LLDP) standard, including "LLDP" and "TLV" and "neighbors," based on his careful review of the LLDP standards at the start of the development process. *Id.* at 148-153.

594. In terms of required LLDP functionality, Mr. Patil also confirmed that several of the LLDP-related CLI commands disputed in this lawsuit relate to mandatory LLDP functionality described in the IEEE 802.1AB standard. *Id.* at 155-156 (discussing the requirement that LLDP-compatible devices support "transmit-only" and "receive-only" and "transmit and receive" modes, and confirming that Cisco's implementation supported those modes); *see also id.* at 157-160 (discussing other mandatory LLDP features implemented in Cisco IOS). Not surprisingly, the LLDP commands at issue in this litigation use the same terms that the LLDP standard uses to describe such standardized functionality. This is because, as Mr. Patil confirmed, he tried to use command names that were familiar to people in the industry as well as accepted industry acronyms:

> **Q.** When you came up with the commands listed on

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> Exhibit 316 [listing of Mr. Patil's commands for which Cisco claimed he was the "author"], did you try to pick names that would be familiar to people in the industry?
>
> … **THE WITNESS:** Yes.
>
> … **Q.** And did you try to use accepted industry acronyms when coming up with the commands listed in Exhibit 316?
>
> … **THE WITNESS:** Yes.
>
> … **Q.** Did you consider the vocabulary of the intended user of the LLDP functionality when you were coming up with the commands listed on Exhibit 316?
>
> … **THE WITNESS:** Yes.

Id. at 170-172.

595. Mr. Patil also confirmed that the development process for implementing LLDP functionality--at least the stages that he was personally involved in--lasted at least three years, and that the process for coming up with new command syntaxes took "maybe three man days to four man days." Patil Dep. Tr. at 62-64, 129-130. For many of his LLDP commands, he testified that coming up with the command syntax took "15 minutes." *Id.* at 188-197.

596. Abhay Roy provided similar testimony regarding several OSPF-related commands, including confirming that many of the words in the CLI commands he added to Cisco IOS came directly from the OSPF IETF RFCs and other RFCs relating to IP and BFD (including well-known and/or standards-defined terms and acronyms like "area,"

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"authentication," "ip," "ipv6," "cost," "hello interval," " deadinterval" etc.). *See, e.g.*, Roy Dep. Tr. at 66-108; *see also generally* Roy Dep. Tr. (discussing the general industry usage and use in standards of words used in all CLI command attributed to him).

597. Mr. Roy also confirmed that he would re-use earlier command syntaxes for "ip" commands when adding new "ipv6" commands, noting "So we looked at -- we looked at what is existing in—in Cisco IOS implementation, and that, generally, is one of the overriding things; that don't reinvent the wheel. If there is something which is done, go with it." Roy Dep. Tr. at 107.

598. Former Cisco engineer Ram Kavasseri also testified at length regarding the SNMP-related commands he added to the Cisco IOS CLI. He noted that his team "was encouraged to participate in the IETF to define use standards around SNMP and network management." *See* Kavasseri Dep. Tr. at 46-48 (also confirming that SNMP is in fact an industry standard defined by the IETF). He also admitted that SNMP has been standardized by the IETF before he even joined Cisco as an engineer, that as a Cisco engineer he read the relevant SNMP RFCs, that he had no idea who came up with the term "SNMP," and that a wide variety of networking vendors used the term "SNMP" during his tenure at Cisco. *Id.* at 48, 53-55, 71-72.[113] Importantly, Mr. Kavasseri admitted with respect to feature development in Cisco IOS that "[i]f the feature had anything specific to do with an IETF document, then yes, I would have had to review the document to make sure I was implementing it correctly[.]" *Id.* at 62-63. It is therefore not surprising that many of the SNMP-related CLI commands in dispute use terms that

[113] I note that Mr. Kavasseri observed that while the IETF may define a protocol like SNMP, it becomes "industry standard only after companies pick it up and support it." Kavasseri Dep. Tr. at 48. In other words, even if formally defined, whether a protocol is actually an industry standard depends on its adoption by multiple companies. *See id.*

are part of, and used by, the SNMP protocol and the associated IETF documents. *See generally id.*; *see also id.* at 148-172 (discussing how several command keywords associated with Mr. Kavasseri's SNMP commands are found in SNMP IETF documents).

599. I note that the examples I describe here are only some of the testimony admitting to the fact that CLI authors typically follow standards documents in choosing command names, and review such documents before implementing any standards-related functionality. The full list of the testimony I have reviewed and relied upon for this purpose is as follows: Individual and Corporate Depositions of Adam Sweeney; Kenneth Duda; Hugh Holbrook; Tong Liu; Anthony Li; Abhay Roy; Ram Kavasseri; Phillip Remaker, Kirk Lougheed, Pradeep Kathail, Devadas Patil, Greg Satz, Terry Slattery, Mark Berly, Charles Giancarlo, Doug Gourlay, Lorenz Redlefsen, Sean Hafeez, Andre Pech, and Jayshree Ullal.

600. The consistency of this testimony from several Cisco engineers illustrates that the addition of new CLI commands for functionality that relates to an industry standard will be preceded by a careful review of those industry standard documents (whether an IEEE or an RFC) so that the engineer can familiarize himself or herself with the relevant networking terminology, the functionality required to comply with the standard, and the terms and acronyms that may be defined by the standard.

601. Cisco's corporate witness on CLI design also confirmed that Cisco engineers have a variety of resources to consult when adding new CLI commands, including industry standards from the IEEE and IETF, as well as customer feedback and the existed command set that may already be supported in the Cisco IOS CLI at the time the new command is being added. *See* Remaker Dep. Tr. at 154-157. Cisco's corporate

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witness on CLI design, however, did not know what any of the "authors" of any of the asserted "command expressions" actually reviewed and considered to come up with the accused commands, and could not refute the standard practice of using standards terms whenever possible. *Id.* at 130-150.

602. A "best practices" document called the Parser Police Manifesto also set forth guidelines regarding the constraints placed on the addition of new CLI commands. *See, e.g.*, Remaker Dep. Tr. at 82-84 (identifying version 6 of the Cisco Parser Police Manifesto as the current version of the document as of the date of the deposition), Exh. 438 (Cisco Parser Police Manifesto, Version 6, CSI-CLI-04824213); *id.* at 40-43 (discussing the 1999 version of the Parser Police Manifesto), Exh. 436 (Jan. 1999 version of the Cisco Parser Police Manifesto, CSI-CLI-00754391).

603. The Cisco Parser Police Manifesto, which has existed at Cisco since at least the late 1990s (*see* Remaker Dep. Tr. at 29), places several practical and technical constraints on the addition of new CLI commands in Cisco IOS, including:

- Select commands so that the parse tree remains extensible and "structure the parse tree not to have 'dead ends.'"
- Use (or don't use) hyphens to ensure that parse chains remain extensible.
- "Watch for collisions. Since the parser looks for smallest unique match, be on the lookout for adding an obscure keyword that conflicts with a common one."
- "When naming a command, try to ***pick names that would be familiar to people in the industry***. For example, 'ip mtu 576' is

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better than 'ip maximum-transmission-unit 576" since MTU is an ***accepted industry acronym***."

- "Do not use code names in commands. 'Debug whizzy-asic' or 'debug walamazoo' will not be very ***useful to customers***."
- "***Commands should tend to be self-explanatory*** so that a relatively knowledgeable user can figure out the command function from the command and on-line help without having to scurry off to the manuals. What constitutes 'self-explanatory' will vary by your target audience, so be prepared to defend that point. While a non-ATM user may find the command 'forward-peak-cell-rate-clpl' offensively complex, the point can be made that this will be ***the only acceptable syntax for the ATM community based on the vocabulary and culture of that user group***."

See CSI-CLI-00754391 (Jan. 1999 version of the Parser Police Manifesto, CSI-CLI-00754391) (emphasis added).

604. As stated in the most recent version of the Parser Police manifesto, these constraints apply to all Cisco OSes that have a CLI interface. *See* CSI-CLI-04824213 (Cisco Parser Police Manifesto, Version 6); Cisco Corp. Dep. Tr. (Remaker) at 38-40 (testifying that most recent Parser Police Manifesto version made it clear that it applied to all Cisco CLIs).

605. Some of the constraints on the addition of new CLI commands are technical in nature and are tied directly to how the CLI parser operates. For example, a new CLI command cannot be the same as an existing CLI command. In other words, you

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cannot have two networking functions tied to the exact same CLI command syntax, as the parser would not be able to determine which of the two functions the user intends to perform.

606. Similarly, the issue of "collisions" is one created by the technical workings of the CLI parser. The use of configuration and other CLI scripts by customers—where CLI commands, or even abbreviated CLI commands, are written out in a careful sequence of CLI commands in order to effect a particular configuration change to a networking device, or perform some other automated functionality on a networking device—nicely illustrates the problem of "collisions" when adding new CLI commands. A well-known short form command (or command abbreviation) like "sh int" for "show interfaces" will no longer work in both the CLI and in CLI scripts if an engineer adds a new command like "show internet" or "share interfaces" because the addition of such commands would render the abbreviation "sh int" ambiguous--and therefore invalid-- as a short form command. CLI scripts that might use the common "sh int" short form of "show interfaces" will then trigger an error and fail.

607. Cisco corporate witness Phillip Remaker testified at length about the importance of avoiding collisions and the impact on customers. *See* Remaker Dep. Tr. at 63-66 (discussing "collisions" and the example of breaking the "sh int" short-form command, and the "unfortunate consequences" it would have on customers).

608. The impact on customers and configuration scripts is also the reason why the Parser Police Manifesto discourages CLI command syntax changes: "***Changing an existing syntax is usually a bad idea***. Once customers are already using a certain syntax, changing the syntax will frequently do more harm than good. … ***[C]ustomers are trained***

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on and familiar with existing syntax. … Having portions of the configuration be unrecognized could cause catastrophic failures." *See* CSI-CLI-00754391 (Jan. 1999 version of the Parser Police Manifesto, CSI-CLI-00754391) (emphasis added); *see also* Remaker Dep. Tr. at 75-79 (confirming the accuracy of these statements and stating "An engineer coming up with a new CLI command, as a best practice, should consider the potential impact on customer scripts.").

609. While I understand Cisco characterized these "constraints" as merely best practices and guidelines, Cisco witnesses repeatedly emphasized the importance of maintaining consistency and usability in the CLI, and in fact all user interfaces, given the purpose and function of a user interface. For example, Mr. Remaker--Cisco's corporate witness on topics relating to CLI command design--testified:

> **Q.** … Why do you believe that customers expect consistency of the configuration interface to Cisco IOS?
>
> **A**. I believe that that is an engineering guideline applicable to all user interfaces.
>
> **Q.** What is the consequence of having an inconsistent CLI?
>
> **A.** Customers will be unable to use Cisco products in the way that they expect.
>
> **Q.** Is ensuring consistency of the configuration interface to Cisco IOS an important consideration when creating new CLI commands?

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> **A.** New CLI commands should be consistent with the design of the existing CLI.

Remaker Dep. Tr. at 45.

610. Mr. Remaker, testifying on behalf of Cisco, also explained the importance to the customers (users) of the CLI of using familiar industry terminology in command words:

> **Q.** … How does picking command words that would be familiar to people in the industry ensure consistency of the CLI? ...
>
> **THE WITNESS:** We believe that's what customers would expect.
>
> **Q.** And how does picking command words that would be familiar to people in the industry ensure usability of the command-line interface?
>
> **A.** We believe that customers would expect that.
>
> **Q.** Customers would expect the CLI commands to use words that would be familiar to people in the industry, correct?
>
> **A.** In the context of the command, yes.
>
> **Q.** When you say "in the context of the command," what do you mean by that?
>
> **A.** One of the attributes of "ip" is "mtu." So "mtu" is a reasonable term to pick related to "ip."

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Remaker Dep. Tr. at 69-70.

611. For the same CLI usability reasons, Cisco's corporate witness, Mr. Remaker, confirmed that using obscure "code names" in new CLI commands is a bad practice because it"***makes the product less usable***." Remaker Dep. Tr. at 70-71 ("**Q.** How does using code names in CLI commands make Cisco IOS less usable? **A.** Customers would have no reason to know our internal code names."). This focus on usability clearly illustrates the functional nature of CLI commands, and the CLI as a whole, and also illustrates the external factors that constrain the selection of CLI commands.

612. Cisco engineer Pradeep Kathail further confirmed these facts at his deposition:

> **Q.** Can you explain to me what criteria you used when you came up with the words to be used in a CLI command? ...
>
> **THE WITNESS:** Most of the time you want to make sure that the words are such that they are self-explanatory, okay, as well as they are the terminology you are using [or "used to"] from the networking world.
>
> *********
>
> **Q.** And you mentioned when Mr. Silbert asked you about make sure that the words are such that they are self-explanatory, what did you mean by that?

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> **A.** You want to use the words where customer doesn't have to go through and read a dictionary and say what does that word mean. So we want to make sure that they are coming from vocabulary which network users use day in and day out so you want to use very known familiar words.

Kathail Dep. Tr. (Rough) at 194 (including corrections of errors in rough transcript since final transcript was not yet available as of the date of this report).

613. I further note that the technical constraints placed on the addition of new CLI commands by virtue of how the CLI parser works is not a discretionary constraint. The creation of a "collision," the addition of a duplicate CLI command, or the creation of "dead ends" in a parse tree directly impacts the functionality of the CLI.

4. Cisco witnesses confirmed that they were already familiar with networking protocols and parlance before adding CLI commands.

614. As noted on several occasions above, Cisco witnesses also routinely confirmed their knowledge and familiarity with common hardware and protocols in the networking industry prior to working on any of the disputed CLI functionality.

615. For example, Mr. Lougheed confirmed at his deposition that he was already familiar with ethernet and ARPANET long before Cisco existed, and long before he purportedly created any aspect of the Cisco IOS CLI. *See* Lougheed Dep. Tr. at 226-227. Mr. Lougheed also repeatedly conceded at his deposition his familiarly with industry terms and phrases that were well known at the time he added CLI commands

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that adopted those terms and phrases:

- He was familiar with Address Resolution Protocol (ARP) long before he purportedly created any disputed IOS CLI features and functionality. Lougheed Dep. Tr. at 79-81, 226-227.
- He was familiar with the term "flow control" in the networking industry. Lougheed Dep. Tr. at 239-240.
- He was familiar with the term "spanning tree" by the late 1980s, well before any accused "spanning tree" commands were added to Cisco IOS, reviewed spanning-tree-related IEEE standards in the late 1980s, and didn't come up with the term "spanning tree." Lougheed Dep. Tr. at 251-252, 331-335.
- He knew that the IEEE had been using the industry standard terms "mac," media access control," and "mac address" at the time he added the disputed "mac-address" command to the Cisco IOS CLI. Lougheed Dep. Tr. at 246-247, 319-321.
- The BGP standardization process had already begun in 1989 with the publication of RFC 1105 in June 1989 by the time he added the "timers bgp" command to Cisco IOS. Lougheed Dep. Tr. at 345-346.
- He was familiar with "RIP" (Routing Information Protocol) when it was an "informal standard" widely adopted in the industry, and used that well-known acronym in commands. Lougheed Dep. Tr. at 125-126.

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- He worked with an IBM employee, Mr. Rekhter, to standardize BGP, and used that acronym in BGP commands. Lougheed Dep. Tr. at 126 to 127.
- He was already familiar with the common networking term "ip address" before he joined Cisco. Lougheed Dep. Tr. at 130-131.
- He did not come up with the common networking terms "domain name" and "domain lookup" and was already familiar with them when adding those commands to Cisco IOS. Lougheed Dep. Tr. at 143-144.
- He was familiar with the well-known industry acronym "MOTD" (message of the day) and did not come up with that acronym for the "banner motd" command. Lougheed Dep. Tr. at 175.
- He was familiar with the well-known industry terms "boot" and "system" before adding the "boot system" command to Cisco IOS. Lougheed Dep. Tr. at 181.

616. Similarly, other Cisco witnesses (including former Cisco engineers) noted their familiarity with industry-standard terms based on prior experience with routing equipment, education, and simply reading the relevant industry-standard documentation before adding new CLI commands. *See* Discussion of Liu, Patil, Roy, and Kavasseri depositions above regarding their reliance on industry standard documents *prior to* adding CLI commands that relate to those standards; *see also* Anthony Li Dep. Tr. at 13-56 (discussing Mr. Li's extensive knowledge of almost all of the routing protocols and standards at issue in this lawsuit, his training on Cisco equipment, and his familiarity with

legacy equipment including UNIX, TOPS-20, and VAX/VMS, which he gained ***prior to*** joining Cisco as an engineer). Indeed, Mr. Li--who added a large number of CLI commands at issue here--readily admitted throughout his deposition that technical terms used in industry standards (including the acronyms for the standards themselves) were well-known to the networking community that used those standards. *See id.*; *see also id.* at 37, 38, 48, 52-55, 107.

617. Importantly, Mr. Li and others freely acknowledged that they had no belief that the terms used in industry standards were proprietary to any one vendor, including Cisco. *See* Anthony Li Dep. Tr. at 109-110; *see also* Lougheed Dep. Tr. at 125-126 (stating that he did not belief "RIP" was proprietary because it was widely used across the industry even before it was described and standardized in an RFC).

618. These examples, and the others cited above, demonstrate that Cisco engineers routinely familiarized themselves with the terminology of relevant networking protocols and common industry parlance before selecting CLI commands, and would use that terminology when adding new CLI commands.

5. Cisco witnesses confirmed that they would copy existing CLI command syntax when adding new commands.

619. Many of the CLI "command expressions" disputed in this litigation are substantially the same or similar to other "command expressions" that already existed in the Cisco IOS CLI. Clear examples of this are commands that relate to functionality of newer versions of a routing protocol--for example, IPv6 and OSPF version 3--where the commands for the newer versions of the routing protocol mirrored the pre-existing commands for the older version of the protocol.

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620. Cisco's corporate witness on CLI command creation, Mr. Remaker, confirmed that Cisco engineers would be encouraged to reuse existing command syntaxes already present in the Cisco CLI when adding new CLI commands to ensure "product consistency." Remaker Dep. Tr. at 150-151. For example, new CLI commands for OSPF version 3 functionality were merely "copies of the corresponding ospfv2 commands." *See* CSI-CLI-00608702.

621. This was also echoed by Mr. Patil (who Cisco identified as the "author" of several LLDP-related CLI commands). When confronted with a document that showed that Mr. Patil had copied the syntax from existing CLI commands for a new command, Mr. Patil testified:

> **Q.** Do you think a user's familiarity with an existing command set is important to consider when adding new commands to a CLI?
>
> .... **THE WITNESS:** I consider that important, yes.
>
> **Q.** And, in fact, in Exhibit 319 here, you use an identical command syntax for something that was already in the CLI for a new command; correct?
>
> **A.** Yes, but it was on a different construct.
>
> **Q.** Sure, but in terms of the command syntax -- and we are using the command syntax -- that was an intentional choice on your part; correct?
>
> **… THE WITNESS:** Yes.
>
> … **Q.** And that was because the users would already

> been familiar with the existing command sets in the CLI; correct?
>
> … **THE WITNESS**: Yes, consistency -- the answer is yes.

Patil Dep. Tr. at 179-180; Ex. 319 (E-mail dated 10/10/07 from Devadas Patil) (CSI-CLI-00836482). Mr. Patil repeatedly confirmed this practice of copying the syntax of existing commands when adding new LLDP commands, where he followed the "exact same pattern as the ones [CLI commands] that were approved on parser-police for basic lldp." Patil Dep. Tr. at 181-182; Exh. 320 (CSI-CLI-00817320). Again, Mr. Patil testified that he did this "for the sake of consistency and skills transfer" for the user. Patil Dep. Tr.. at 182-183.

622. Mr. Patil also confirmed that he tried to copy the same command syntax for new LLDP commands as Cisco used for already existing CDP (Cisco Discovery Protocol) CLI commands. Patil Dep. Tr. at 209-210.

623. Perhaps most important, Mr. Patil confirmed that he did not even consider departing from the established command syntaxes already in Cisco IOS when adding new LLDP commands to Cisco IOS. Patil Dep. Tr. at 183 ("Did we consider doing a very different syntax? No.").

624. Similarly, where an existing "command hierarchy" already existed (for example, there were already commands in Cisco IOS that started with particular keywords), Cisco witnesses testified that they were constrained by those existing commands and command hierarchies already supported by the Cisco IOS CLI. In many cases, those prior, pre-existing Cisco IOS commands are ***not*** at issue in this lawsuit, and

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Cisco has provided no evidence that those pre-existing commands were original or creative.

625. For example, Mr. Lougheed admitted at his deposition that after there were already commands using the "'IP' as the keyword indicating Internet protocol-related stuff, [he] would have felt constrained to use that as the leading keyword" in subsequent new commands. *See* Lougheed Dep. Tr. at 317-318. And Mr. Lougheed also confirmed that once "show" commands were introduced into Cisco IOS, he was constrained to use "show" for all subsequent commands that provided information. *See id.* at 326-327.

626. And Mr. Patil confirmed that when he added "show" and "clear" commands relating to LLDP functionality, he just reused "show" and "clear" in those commands because they were already being used by other CLI commands in Cisco IOS. Patil Dep. Tr. at 199-200.

627. Examples of such "re-used" command syntaxes can be gleaned from reviewing Cisco's asserted list of commands, although in certain cases, the "old" command that was later copied by Cisco's engineers is not asserted in this lawsuit. For example, "area default-cost", "area nssa", "area nssa default-information-originate", "area nssa translate type7 always", "area range", "area stub", "default-information originate", "default-metric", "log-adjacency-changes", "maximum-paths", "passive-interface", and "router-id" are all commands that are listed multiple times by Cisco for different versions of OSPF (and, in the case of "log-adjacency-changes", it is listed also for IS-IS.

628. Other clear examples of replicated commands include IPv6 commands,

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such as "show ipv6 bgp" and "show ipv6 ospf" families of commands, which largely replicate the "show ip bgp" and "show ipv6 ospf" families of commands.

6. Cisco witnesses confirmed that they would spend a minimal amount of time on the syntax of new commands.

629. As noted earlier in this Report in my discussion of the development process followed by Cisco engineers, several Cisco witnesses confirmed that the time and effort spent on coming up with the syntax for new CLI commands was insubstantial compared to the planning and source code writing that was required to implement the functionality associated with the commands.

630. For example, Mr. Lougheed confirmed that coming up with the syntax for the CLI command "ip access-group" took ""not very long" and a matter of minutes, as compared to a day's worth of time writing source code for the underlying functionality. *See* Lougheed Dep. Tr. at 317-319. And Mr. Satz testified that took all of fifteen seconds to come up with CLI commands for functionality that he estimated took months to create. Satz Dep. Tr. at 76. Similarly, Mr. Patil confirmed that for a project that took months to complete, for many of his LLDP commands, he came up with the command syntax in "15 minutes." Patil Dep. Tr. at 188-197.

631. This further emphasizes the minimal (if any) creative effort behind the addition of CLI commands, particularly given the constraints on the selection of CLI commands--both functional and technical--discussed earlier in this Report with respect to the Parser Police Manifesto and the re-use of existing CLI command syntaxes.

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7. The Asserted CLI Command Hierarchies are not original.

632. I have already discussed the purely functional nature of command hierarchies, and the testimony provided by Cisco witnesses regarding hierarchies from Mr. Remaker and Mr. Lougheed, in my discussion of why the CLI is a method of operation, which I incorporate by reference into this section.

633. That idea of organizing related commands in a logical tree-like structure was not original to Cisco. As explained earlier in this Report in my discussion of legacy systems (which I incorporate into this section), early Cisco engineers, including Mr. Lougheed, had extensive experience with and were exposed to legacy systems like UNIX and also systems manufactured by DEC (including TOPS-20 and VAX/VMS) that had CLIs that organized commands in a hierarchical way. Mr. Lougheed also worked directly at Stanford, prior to joining Cisco, with a print management program that used a hierarchical command syntax, including support for a "show" command hierarchy. *See* Lougheed Dep. Tr. at 260. Similarly, as discussed earlier in this Report, DEC systems as early as 1980 supported a structured, multi-word command syntax that followed a hierarchical "verb" "object" "parameter(s)" structure, including "clear" and "show" command families. *See* ARISTANDCA13228703 at Pages 29-35 (DECnet DIGITAL Network Architecture (Phase III) Network Management Functional Specification Order No. AA-K181 A-TK Version 2.0.0 October 1980); *see also* Anthony Li Dep. Tr. at 23-24 (discussing the structured syntax of TOPS-20 and VAX/VMS); *id.* at 145-146 ("So the Cisco user interface was taken -- the model was TOPS-20, so many of the external functionality in the CLI was similar to TOPS-20."); *id.* at 154 ("The infrastructure, the

look and feel of the Cisco CLI had already been set. The model was very clear from TOPS-20.”).

634. Indeed, Mr. Satz—who worked alongside Mr. Lougheed at Stanford before Mr. Lougheed joined Cisco—confirmed that the DEC equipment at Stanford followed a hierarchical structure, and discussed how “show” commands in the DEC NCP (Network Control Program) CLI are used in a hierarchy. *See* Satz Dep. Tr. at 39-50; Exh. 401 (“TOPS-20 DECnet-20 Programmers Guide and Operations Manual”).

635. Cisco’s organization of the disputed multi-word CLI commands into such a tree-like structure was therefore not original. Moreover, to the extent that individual Cisco engineers simply copied the existing syntactical structure of existing Cisco IOS commands (for example, simply re-used “show” as the first command word, or simply re-used the “show ip bgp” structure for a new command), such copying of an existing hierarchy is just as unoriginal and devoid of creativity as copying the command words themselves from prior commands.

8. The Asserted CLI Modes and Prompts are not original.

636. As discussed in detail above, Mr. Lougheed admitted that [redacted] My analysis of those pre-Cisco systems confirms that they supported those command modes, and that the idea of separating CLI users into a “privileged” mode (where they could access more commands) and a “non-privileged” mode (where they could not access “privileged” commands) was known to Cisco engineers before the Cisco IOS CLI was developed.

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9. The Asserted CLI Command Responses are not original.

637. The majority of the information that Cisco claims as protected command responses also fails to pass the originality threshold. The snippets that Cisco cites are minimal descriptive phrases regarding switch features and functionality. The substance of the phrases derive from the functionality of the device and industry terminology used to define that functionality.

638. For example, former Cisco engineer Tong Liu confirmed that the "show" command outputs for PTP-related commands, for which Cisco identified Ms. Liu as an "author," contained system-specific real-time configuration and state information about PTP parameters and objects (like the PTP-defined "grandfather clock") that were defined by the IEEE 1588-8000 PTP standard, because that standardized information would be "meaningful to show to the user."[114]

639. Consider also the excerpts of IGMP multicast configuration state that Cisco claims.[115] Here Cisco cites such mundane phrases as "IGMP version" and "Robustness value" (neither of which Arista uses). The phrases Arista does use are similarly mundane: "startup query count" and "last member query response interval." But the concept of a "query" in IGMP is set forth in the relevant IETF RFC.[116]

640. Cisco documents also emphasize the importance of clear command outputs that use industry-standard terms and abbreviations: "Counters SHALL use industry-standard abbreviations based on RFCs and other specifications. When no industry-standard abbreviations are available, counters SHALL be human-readable.

[114] Liu Dep. Tr. at 167-172.
[115] 9/1/2015 Cisco Supp. Resp. to Int. 2, Exh. E, at 9.
[116] See generally, RFC 2236, RFC 3376, RFC 4604.

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Interface counters SHALL be displayed in show interface or in command output separate from show controllers." *See* CSI-CLI-00779340 (Cisco engineer proposing a "counter manifesto" to the Parser Police).

641. I have reviewed all of Cisco's Exh. E, which purports to set forth the relevant asserted command responses, and with the exception of at most few descriptive words connecting industry standard terms together, I find that the purported copied command response excerpts are derived from industry standard materials.

C. Summary of Opinions re Originality

642. As described more fully above, substantial portions of the asserted CLI commands, hierarchies, modes, prompts, and responses were not created independently by a Cisco author. Instead, they were either copied directly from another work or they were derived from another work, or common industry parlance. **Appendices A and B**, as well as **Appendix G**, contain an additional assessment of all disputed command keywords that, in my opinion, are not original to Cisco. I address the remaining portion of the asserted protected expression in subsequent sections.

X. ANALYSIS OF *SCENES A FAIRE* DOCTRINES

643. I have also been asked to analyze whether the asserted copyright infringement claim advanced by Cisco implicates the so-called "*scenes a faire*" doctrine. In so doing, I have considered a number of potential factors that limit the choices a Cisco engineer would have faced in deciding what command keywords to use to invoke a given function. I understand that, in applying the *scenes a faire* doctrine to the context of computer software, one should consider the effect the following factors may have on the composition of asserted protected aspect of the "works": hardware standards and

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mechanical specifications, software standards and compatibility requirements, computer manufacturing design standards, industry programming practices, and practices and demands of the industry being serviced. I understand that the purpose of this doctrine is to exclude from copyright protection expression whose creation flowed naturally from considerations external to the author's creativity.

644. I start with the fact that using a command line interface itself is not original to Cisco, so the fact that there are other potential means of controlling a network switch--such as a graphical user interface, or other programmatic interfaces--is not pertinent to whether the similarities between Cisco's and Arista's CLI aspects are *scenes a faire*. Cisco having chosen to follow the path of predecessor operating systems such as UNIX and TOPS-20 by using a CLI, the *scenes a faire* analysis should focus on what constraints limited each CLI author's choice of command words.

645. Within the context of a CLI for a networking switch, there are a host of external forces that severely constrain one's choice of words to use in the commands. An important indicator of what Cisco's CLI authors followed when arriving at commands is the Parser Police Manifesto described above.[117] It advises to use terms that are familiar in the industry, only use acronyms accepted in the industry, and urges that commands be self-explanatory to avoid frustrating users. It also cautions against commands that lead to "dead-ends" where it is impossible to extend a feature with a new sub-feature, and warns of "collisions" that can occur when the shortened "command-completion" version of one

[117] I understand that Arista sought, but Cisco successfully opposed, the deposition of each CLI author. As a result of Cisco's successful opposition , there is not direct evidence about the "creative" process for each command. I reserve rights to supplement this section with any further evidence that may come to my attention prior to trial.

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command is the same as another, causing scripts to fail. These are all external factors that limit the practical options available when selecting the words for a CLI command.

646. CLI commands are, in essence, a short-cut for a more complete description of the functionality that the command invokes. As with any naming convention, one hopes the the short-cut is sufficiently descriptive and unambiguous so as to make it relatively easy for the user to remember and associate with the function using terminology that is common in the industry for such functionality. So, for example, although one could technically construct a system that recognized the word "giraffe" instead of the command "clear ip bgp all," there is no reason a user would associate the word "giraffe" with the function of that command: ie, resetting address family sessions for the Border Gateway Protocol.

647. Cisco's own Pradeep Kathail confirmed the importance of "mak[ing] sure that the words are such that they are self-explanatory, okay, as well as they are the terminology you are using from the networking world. . . . You want to use words where [the] customer doesn't have to go through and read a dictionary and say what does that word mean. So we want to make sure that they are coming from vocabulary which network users use day in and day out so you want to use very known familiar words."[118]

648. This obvious constraint of CLI command choice was driven by Cisco's business need to keep customers happy. As Tony Li explained: **Q.** To what extent, if at all, was the use of industry-standard terminology encouraged in Cisco's command sets? **THE WITNESS:** So the use of industry-standard terminology was encouraged largely by the engineering community of which much of Cisco's development was driven by

[118] Kathail Dep. Tr. (rough) at 194-195.

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simply because it minimized confusion."[119] Accordingly, I adopt here the entirety of analysis and discussion in other sections of my report detailing the relationship between asserted CLI commands and legacy operating systems and industry standard terminology.

649. While it is true that one could potentially use a different word order for certain commands, because these commands are typically no more than three or four words long (nor can they be much longer if they are to be usable), there are very few available reasonable options for such short phrases. For example, one could imagine replacing some non-technical terms with synonyms (the most obvious example being using "display" instead of "show"). But there are a very limited number of reasonable synonyms for the concept of "showing" the state of a device or network. If one company were deemed to have copyright in the use of descriptive terms to implement or access device functionality, it would effectively limit the number of possible competitors in the field to the number of practical synonyms for the functionality. Likewise for commands consisting entirely or almost entirely of conventional industry terms, there are limited reasonable options for ordering those words. And to suggest that one company can have exclusive rights over a particular ordering of a three or four word phrase would mean that there could only be several competitors in a field before any new entrant in the market would inevitably be stepping on some other competitors' word order.

650. Apart from need to follow conventional industry nomenclature, I would summarize the other key external factors that constrain the choice of command keywords

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[119] *See* Anthony Li Dep. Tr. at 129-130; *see also* Satz Dep. Tr. at 93-94, 158-159, 162; Liu Dep. Tr. at 174-179; Kavasseri Dep. Tr. at 133-139; Roy Dep. Tr. at 51, Ex. 53; Patil Dep. Tr. at 170-172, Exs. 316, 318; Remaker 30(b)(6) Dep. Tr. at 35, 45-47, 53-55, 67-73, 109, 156-157 Exs. 436-439; Berly Dep. Tr. at 33-34; Holbrook Dep. Tr. at 62-64.

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as follows: English usage, brevity, clarity, extensibility and efficiency in the parsing of the commands. I discuss each of this in further detail below.

English usage rules:

651. Many of the asserted commands are for the purpose of ***showing*** status or ***clearing*** settings. These show and clear commands are distinct from commands that are for the purpose of turning a feature on or off or inputting a setting, in which the action of the command is implicit. For these "show" and "clear" commands, the structure of them is simply common English usage: [verb] + [protocol] + [argument]. This syntax is driven in part simply by the way English speakers think. Therefore, for any command for which it was determined a verb was needed to clarify the function that the command represents, the word order would be driven by grammar rules. This substantially limits the reasonable options for alternative CLI commands. While it may be possible to place "show" at the end of a string of command words, there is an obvious grammatical reason to use, e.g., "show mac-address-table count" rather than "mac-address-table count show I will also note that Cisco's use of this format was not original to Cisco; the TOPS-20 software that the very earliest Cisco engineers worked with at Stanford followed this identical syntax.[120]

Need for brevity:

652. As confirmed by numerous witnesses, the purpose of a CLI command is to allow access to the desired function with as little difficulty as possible. Therefore brevity is another external factor limiting the selection of commands. One wants to gain access

[120] Satz Dep. Tr. at 39-50 (discussing DEC equipment at Stanford while Mr. Satz worked with Mr. Lougheed, and the command syntax used by that DEC equipment); *See also*, ARISTANDCA00038298 (TOPS-20 Manual)

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to the feature with as few keywords as possible. For this reason almost every CLI, both those preceding Cisco's CLIs and to the present day, virtually never include the articles, flavor words or punctuation that standard English demands. For example, no CLI requires (or even allows) a command like, "Show me the current internet protocol routing table for this device, please." Instead the command is, "show ip route". The latter form reduces the chances for ambiguity, greatly simplifies parsing and (most importantly) requires less typing. In addition, it reduces the likelihood of error that comes with a system whereby the computer needs to understand nuance and vocabulary differences of each user's english writing style.

<u>Need for clarity:</u>

653. A corollary to the need for brevity is the need for clarity and to avoid ambiguity. This manifests itself in the selection of industry standard terminology, to be sure. But in addition, it is important that command words are not selected that easily lead to parsing errors because abbreviated commands are similar. This could result in the so-called "collision" problem described above in the Parser Police Manifesto. For example, Kirk Lougheed was asked what alternatives he considered for the (partial) command "ip host." He said "name" or "network system" or "system" were alternatives he considered.[121] But these alternatives suffer from various problems. "Name" is brief, but it is vague: "name" of what? "Network system" is awkward for its length, among other reasons. And "system" is not only longer than host but is also vague, like "name." This

[121] Lougheed Dep. Tr. at 132.

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is not to say that a CLI using "ip system" could not function; it could. But there are plainly external factors that make "host" a more attractive term than the others.[122]

654. In any event, if one vendor used "ip host" and another used "ip name" and a third used "ip system," I cannot discern any purpose served by requiring the fourth entrant in the market use a yet more ambiguous or awkward term. But perhaps most compelling here is the following fact: prior to the invention and widespread adoption of DNS, hostname-to-ip-address mappings were stored on each computer in a file called "/etc/hosts" (pronounced "et-see hosts"). This was well-known to system administrators of the time, and was no doubt known to Mr. Lougheed. This file predates Cisco and was in no way created by Cisco. The "ip host" command serves the very same purpose as the /etc/hosts file: to collect mappings from host name to ip address. Therefore it would be very odd to ignore both "host name" and "ip address" in formulating a CLI command and decide instead to call it "name" or "network system" or "system" when most users would be expecting something with "host" and with "ip" as part of the command. If I look in my /etc/hosts file on the computer I am using right now, there is an entry "174.25.36.58 moxie" indicating that I have added that mapping to my local machine[123]. If I wished to do the same thing using Mr. Lougheed's syntax, the CLI command would be "ip host moxie 174.25.36.58", a nearly verbatim capture of the protocol, filename, and contents of my /etc/hosts file.

[122] Mr. Lougheed conceded that he was aware of others using the word "host" in the computer field before he arrived at the CLI command "show host." *Id.* at 170.

[123] This means that any time I enter "moxie" where the host name of a computer is expected, my machine will translate this to 174.25.36.58. Other computers will not see this mapping. The DNS system enables what is effectively a worldwide /etc/hosts file.

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655. Clarity to the user is an obvious priority for any vendor. Not surprisingly, Cisco documents show debates about CLI selection where clarity is cited as a reason for one command over another.[124] As with all of the terms at issue, one can debate whether a particular alternative is better or worse, but there is no debate that the number of reasonably clear alternatives are quite limited.

Need for extensibility:

656. Operating systems are constantly being upgraded, and networking operating systems are no exception. It is standard practice that vendors add features as they are developed either internally or as advances are made in the industry and published in RFCs or other sources. At the same time, there are a number of reasons why customers do not want their existing software to change merely for the purpose of incorporating a new feature. As it relates to networking operating systems, this need for "backward compatibility" is driven both by the familiarity human users have with the "old" version as well as existing tools and scripts that are designed to run on the old version of the software. A new version that is incompatible with the old version causes scripts to break and network administrators frustration, or worse, errors.[125] Therefore a fundamental tenet of software design is that, to the extent possible, new features can be added with minimum disruption to the existing installed base. Software engineers call this "extensibility," and it has been a factor in CLI selection for as long as there have been CLI commands.

[124] CSI-CLI 00749938 ("we shouldn't send the user to the manual to find the meaning of the command."); *see also* CSI-CLI-02560937 ("User terms that are clear and familiar to the user. Do not use code names or acronyms unless they are the standard, well-accepted terminology."); CSI-CLI-00790956 ("Config commands should be relatively intuitive, and use terms which describe the feature or mechanism in question. Not a list of obscure indirect references and codes."); *see also id.* (noting that using specific RFC numbers as command keywords woudl be "meaningless to most customers").
[125] See e.g., Exh. 86 (Article re Origins of Cisco CLI).

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657. Cisco engineers demonstrate this constraint in debates about CLI design. For example, in the email debate described above about a "radius-server" command, one Cisco engineer suggested adding a "default" for purposes of extensibility, and another suggested breaking up a hyphenated phrase.[126] The point being that proper consideration of extensibility will constrain the freedom of choice in command words.

658. Take, for example, the commands beginning with "ip" and "ipv6." IPv6 is a later version of the IP protocol ("ip" actually refers to ipv4), that provides for *inter alia* larger ip addresses. Much of the functionality within the ip domain is equally available within the ipv6 domain, and vice versa. Therefore, as one contemplates a command set for ipv6, one is constrained by the various functional commands already in place for "ip" and one would arrive at a structure that can make all familiar commands available to the user in either domain with a minimum of alteration of command keywords. The Cisco command set follows the convention of prepending the protocol name ("ip" or "ipv6") to the same general family of commands, which is the most obvious way of accomplishing the stated goal of extensibility and backwards compatibility.

659. This is why numerous Cisco documents, including the Parser Police Manifesto discussed earlier in this Report, state in no uncertain terms: "Commands should be extensible. If you add a command, provide a way that more similar commands may be added without adding new top-level commands. Avoid 'dead ends' in the parse tree." CSO-CLI-02560937 ("Cisco UCD CLI Guidelines"); *see also* CSI-CLI-04824213 (Parser Police Manifesto, Version 6).

<u>Need for efficiency in parsing of commands</u>

[126] CSI-CLI 00749938.

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660. Parsing commands requires recognizing each keyword or parameter until a complete command is received and then implementing that command by way of calls to other routines in the software. While there are many issues that may make one parser better than another, a minimally effective parser will be designed to operate quickly, without errors (except when the command itself is in error) and will allow for command completion, as described above. As a consequence of these desired parser attributes, it would be absurd to use different terms in different commands when you have already built a parser to recognize a certain keyword. For example, once one decides (as Mr. Lougheed apparently did) to follow the convention of numerous legacy operating systems and use "show" as a keyword, Cisco was practically constrained to use "show" for all later commands that would result in showing some data or state of the device. The parser was already designed to recognize "show" and then move to the next command word; there is no reason to add to the parser a module that would recognize some synonym for "show" such as "display."[127] In fact, doing so would only cause confusion and likely error and frustration.[128]

661. In theory, one could create entirely new and different commands for each discrete subfeature. Thus, one could build a parser to recognize "show ip route" but instead of using the command "show ip route tag" one could build the parser to recognize that function by the command "Go Giants." Such a parser could function, but it would be

[127] Lougheed Dep. Tr. at 169 (explaining how he was "already constrained by the choice of that keyword [show] to -- for displaying internal data information").

[128] [redacted]

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incredibly inefficient, particularly when multiplied over hundreds of commands. Thus, any rational engineer devising a set of CLI commands will always use existing command keywords wherever possible.

662. Finally, for command completion to be most efficient, the parser must recognize unambiguous commands by only a few keystrokes. Therefore one would attempt to choose words that do not have in common many initial letters as other keywords because doing so will require the user to type out the entire command to arrive at an unambiguous keyword.

663. My analysis above comports with the way the CLI was treated by Cisco in its litigation against Huawei 13 years ago. For example, there Cisco ultimately agreed to allow Huawei to continue to use the syntax of [verb] +[protocol] + [argument] despite initially attempting to force Huawei to use a different structure.[129] This outcome is consistent with a number of observations above..

664. In addition, Cisco agreed to a procedure whereby a mediator would resolve any disputes about the similarity of Huawei's commands, and in this procedure the mediator was required to take into account: "(i) common terms and commands used in the industry; (ii) common acronyms; (iii) standards based terms; (iv) the normal range of ten percent to twenty percent (10%-20%) similarity between the CLI command names used by industry participants and the Cisco CLI; and (v) the non-protectabile aspects of the Cisco CLI."[130] I agree with Cisco that these factors are all relevant for determining

[129] Consider CSI-CLI-02555741--Huawei report arguing against copyright protection in this context; CSI-CLI02555798 final agreement providing for only minor cosmetic changes; *see also* Sweeney Dep. Ex. 127
[130] CSI-CLI-02446718 at Section 4.01.

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whether any similarity between command sets is due to external factors as opposed to author creativity.

665. I am also aware that, at times, engineers have debated variations on proposed CLI commands, whether via Parser Police or otherwise. For example, there were discussions with the Parser Police regarding certain LLDP commands associated with Mr. Patil. *See* CSI-CLI-00817320 (Patil Dep. Exh. 320), CSI-CLI-00817660 (Patil Dep. Exh. 321); CSI-CLI-00810826 (Patil Dep. Exh. 323; CSI-CLI-00811125 (Patil Dep. Exh. 324). And there were also Parser Police discussions relating to commands associated with other Cisco engineers. *See, e.g.*, CSI-CLI-00746246 (Anthony Li Dep. Exh. 150); CSI-CLI-00746246 (Anthony Li Dep. Exh. 152); CSI-CLI-00846656 (Tong Liu Dep. Exh. 97). The essence of these email debates regarding command selection further demonstrates the external constraints that exist in arriving at CLI commands. Participants in the debates challenge one another about whether a particular command will be understood by users, or whether it will pose some problem regarding extensibility, or whether it will be confused with some other command. The alternatives that the participants in these debates consider are not evidence of a creative process. Rather, in my opinion, these debates show engineers attempting to reach consensus on functional superiority, balancing the different external constraints described above.

666. In sum, it is my opinion that the *scenes a faire* doctrine excludes from copyright protection the asserted aspects of the of the Cisco CLI. CLI commands are not poetry, nor are they inscribed on a blank slate. They are selected for purely functional purposes, never made to be read or recited but rather typed into a computer, typically in as abbreviated fashion as possible. Industry standard terminology, the need to clearly and

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succinctly communicate the command's function, and legacy system terms all constrain the scope of reasonable command keywords one would use as well as how to organize and label command response screens. These conventions also provide practical limits on the modes and prompts to be used without causing unnecessary confusion. The hierarchy of commands is driven entirely by the functional needs of the parser and the functional goal of organizing like commands logically. The factors I set forth above further constrain the choices of alternatives available to the engineer choosing a CLI command. While alternatives no doubt could function, any effort to create alternatives quickly leads to a point where other vendors are penalized for having to use awkward or confusing commands because the logical commands are already "used" by legacy vendors.

667. Cisco has not elaborated on what alternatives were available to its CLI authors and prevented Arista from obtaining discovery from many of those authors. I reserve my right to respond to any such evidence and and when it is presented, and to adjust this opinion based upon the specific alleged infringement that Cisco will assert at trial.

XI. ANALYSIS OF SHORT PHRASES DOCTRINE

668. CLI commands are, of necessity, short phrases. As such, they allow for few reasonable alternatives, as explained above. Cisco engineers agree.[131] I understand that the Copyright office has explained that phrases such as a name or a title are not the proper subject of copyright protection. http://www.copyright.gov/help/faq/faq-protect.html. I've been asked to consider how this doctrine may apply to the asserted

[131] CSI-CLI 00749938 ("It's always hard to find a short phrase that is descriptive").

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aspects of the Cisco CLI. It is my opinion that this doctrine applies in two ways to the assertions here.

669. First, the asserted CLI commands are effectively the name given to the operating system functionality that the command is designed to invoke. Each valid command is parsed until it can be associated with only one unique function (otherwise it is an invalid or incomplete command) and then it is executed.

670. The short phrases doctrine also comes into play in conjunction with my analysis of originality and *scenes a faire* described above. As shown in **Appendix K**, once one filters out the terminology that comes from legacy operating systems and from standard industry usage including IETF RFCs and specifications, there are few words left of all of the asserted command keywords. The assessment of creativity, in my opinion, starts and ends with what Cisco engineers may have contributed to this body of vocabulary that does not merit copyright protection. In that case, there are strikingly few words out of all of the asserted multi-word commands that could qualify as Cisco creativity. For example, the command "clear ip mfib fastdrop" relates to a multicasting function. I understand this command was selected by Hugh Holbrook, when he was at Cisco. As explained above and in the Appendix, "clear" is an old legacy command, and "ip" and "mfib" are well-known industry standard terms[132]. Mr. Holbrook was not certain where the term "fastdrop" came from,[133] but even if Cisco could demonstrate that he or some Cisco employee coined it, the sum total of creative expression added by Cisco would be that one word. To the extent commands consist of *any* keywords other than standard or legacy terms, there is generally only one word purportedly contributed by

[132] The industry term "ip" has been described throughout this report. "mfib" is described in RFC 4601.
[133] Holbrook Dep. Tr. at 180.

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Cisco engineers. Where the extent of potential creativity consists in the addition of only one or two words, the short phrases bar to copyright protection would apply. I have tried to indicate where that doctrine applies in **Appendix K.**

XII. ANALYSIS OF FAIR USE FACTORS

671. I provide below a summary of my analysis of the fair use factors. This summary is intended to encapsulate in a convenient form, but in no way to limit, the opinions relating to fair use that I express and elaborate on throughout this Report.

A. The Purpose and Character of the Use

672. As noted above, Cisco does not allege that Arista's EOS copies source code from IOS or any other Cisco operating system. The architecture and source code underlying Arista EOS were independently developed by Arista engineers. I am not aware of any allegations by Cisco that any of the Arista source code underlying EOS was copied from the Cisco IOS source code, and I have seen no evidence in my review of source code in this litigation to support any such allegation of source code copying. Cisco's copyright allegations directed to the functionality of the Arista EOS CLI is not directed at any literal EOS source code, but instead at non-literal functionality of the EOS CLI in its operational aspects.

673. With this in mind, I have undertaken an evaluation of the purpose and character of the use of the asserted CLI aspects in relation to the registered works. In particular, I have considered whether the alleged infringement is a transformative use of the asserted protected expression. Based upon all of my observations set forth above, it is my opinion that Arista's alleged use of the asserted CLI aspects is a transformative use because of the fundamentally different and novel Arista hardware and software that

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Arista developed independently, and because the asserted CLI aspects are merely a means of accessing or controlling some of that innovative technology. By using the asserted CLI aspects in this way, Arista has altered the asserted "expressions" with new expression, meaning, or message, at least in the following ways discussed below.

674. First, the Arista hardware design has delivered performance substantially above its competition for many years, and while hardware design is constantly being updated with the increases in chip technology thanks to Moore's law and other innovations, Arista's hardware performance has attracted substantial praise and interest.[134] Arista has been particularly strong in delivering products with low latency, meaning reliably very fast throughput of packets, for customers with time sensitive data such as financial services.[135] Arista has also led the industry in port density, with 64 QSFP100 ports in a 2RU form factor. Port density is often a critical factor for builders of data centers where servers are getting smaller and therefore the networking demands within a rack are growing. Additionally, the high density, high speed ports allow for "non-blocking" switching and thereby enable cloud data center architectures that would otherwise have been impossible.[136] Arista has also been ahead of the competition in power consumption with top-of-rack switches using under 7 watts per port and 4 watts per port for their larger chassis switches. Power consumption is a critical metric for large data centers that consume enormous amounts of power; the operating costs of these data centers is substantial. Arista's hardware (and software) design has resulted in very efficient devices. Arista uses "merchant silicon" instead of building custom chips. This

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[134] *See e.g.*, ANI-ITC-944_945-0785404; ARISTANDCA0027854; ARISTANDCA00277567; ARISTANDCA00277567; ARISTANDCA00281053.
[135] ANI-ITC-944_945-0785404.
[136] http://www.arista.com/en/products/eos/cloud-scale-architecture.

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choice has benefited them in two ways: (1) there is no need to design ASICs that will be outmoded and outdated within a few years and (2) using another company's network switching chips saves money overall which allows Arista to provide better price/performance to its customers.

675. These superior hardware characteristics do not rely upon the CLI in any way, and the innovations that yield this performance are not related to the CLI. Rather, as described above, the CLI merely the means by which a user unlocks the potential of the Arista switch. The CLI used with Arista switches is akin to putting a familiar headlamp control knob on a high-performance automobile--the headlamp knob will doubtless be welcome and used but the auto on which it is mounted is completely innovative. The product is defined by its innovation, not the use of a familiar small feature.

676. Second, after considering hardware design I considered whether, within the software context and in view of EOS generally, Arista's use of the asserted CLI aspects is transformative. As explained above, the EOS CLI is only one aspect of EOS as a whole, and is merely an interface that people use to in order to ***access*** the engine (*i.e.*, the networking functionality) of EOS. The commonality of CLI commands is provided solely for the purpose of the user experience, not for the execution of the functions of EOS.

677. I also understand that EOS was purposely designed and written from scratch so that it would not be encumbered by legacy networking operating system architecture, which had been designed as a large monolithic operating system with the attendant lack of fault tolerance. Additionally, Cisco's IOS had been revised and

versioned so many times, with so many patches, all while trying to maintain backwards compatibility, that it was commonly referred to as "spaghetti code."[137] By writing its EOS code from scratch, Arista did not have the burden of backwards compatibility, nor was it facing the inertia of millions of lines of OS code that represented decades of Cisco bug fixing. This gave Arista the freedom to create a completely new operating system which was specially designed for the modern data center--a new paradigm--unlike Cisco's operating systems, which had originated for other applications and been adapted for modern data center use.

678. I have discussed the characteristics of EOS that make it transformative in its use of the asserted CLI aspects already in this Report, including in the "Background of the Technology" where I discuss in detail the innovative features and characteristics of Arista's products, including EOS. I incorporate that discussion in its entirety in my analysis of this and other fair use factors. Those EOS characteristics include, without limitation, the following:

i) [redacted]

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[137] CSI-CLI-01313233 at 40.
[138] *See e.g.* ARISTANDCA00268465 at 27-29; ARISTANDCA12465565 at 25.

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ii) EOS uses a substantially unmodified Linux kernel. This provides stability and reliability, among other benefits, and means that the Linux kernel can be patched and updated without Arista needing to reapply its modifications and risk conflicts and incompatibilities.

iii) EOS utilizes a central database store configuration data for both the device and the various "agents", as opposed to the conventional approach, which typically involves a single process running in a single address space. As part of this new modular architecture, each agent of the operating system runs separately from the others. This provides resiliency, and allows for software patches while the operating system is running. This also results in high availability, among other benefits.

iv) EOS is fully programmable and extensible at all levels, allowing users to add applications, scripts or extensions freely.

v) EOS includes a latency analyzer feature known as LANZ to capture and report statistics, particularly when network problems arise.

vi) EOS includes "zero-touch provisioning" (ZTP) to allow automatic configuration upon start up. This feature is particularly attractive to large cloud customers and data centers.

vii) EOS includes a programmatic management feature known as eAPI, which allows the user to *bypass* the human use of the CLI to configure and manage network switches programmatically using the CLI, which is more suited to data center automation.

viii) EOS includes VMTracer, which is a tool for managing virtualized environments, which are extremely common in today's modern data center.

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679. I incorporate herein the entirety of my discussion above regarding EOS and its innovative developments and features as a basis for my opinion on fair use.

680. In sum, Arista's decision to allow its users to interface with the Arista switch using the asserted familiar aspects of the CLI provided for a transformational use of those CLI aspects. Arista uses the accused CLI aspects in a very different context than Cisco's use of those aspects, and that change in context makes the Arista products (and EOS within those products) a very different creation from the Cisco products (and IOS within those products). To offer an analogy, an electric car might use a steering wheel, brake pedal and accelerator that would be familiar to a driver of a traditional car with a combustion engine. Notwithstanding the similarity of those functional controls, the typical driver would readily recognize that the electric car is a new creation. The asserted CLI aspects allow users to unlock and gain access to something unquestionably new and innovative, the Arista switches running EOS. The vast majority of the registered works are not alleged to have been used by Arista in any form; in fact Arista eschewed IOS and NX OS. More than "transforming" the registered work, Arista rejected it and built from scratch. But by providing customers with a some familiar interface features, it allowed those customers to access the innovation and so make use of the asserted CLI aspects in a highly transformative way.

B. **The Nature of the Copyrighted Work**

681. The second fair use factor is the nature of the asserted works. The asserted copyrighted works in this case consist of versions of source code and their associated documentation. I understand that computer programs are typically considered primarily functional under the copyright law, and in the case of Cisco's IOS, NX-OS and

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IOS-XR, that is certainly the case. In fact, the source code is highly confidential and so not shared outside of Cisco. Its compiled version executes on various Cisco switches and other devices, but they are a purely functional work. Importantly for this case, however, I am not aware of any allegation that Arista copied any source code of Cisco's. The asserted aspects of the works that are allegedly copied are functional elements of these inherently functional works; that is, CLI commands, modes, prompts, responses, etc.

682. As I have noted throughout this Report, including in my discussion of the CLI as being a method of operation, it is my opinion that CLI commands, modes, prompts, hierarchies, and responses are functional, and not expressive. The commands serve as an access point to features of the respective operating systems. I am not aware of any evidence that they are appreciated in their own right, nor that anyone even considers the asserted CLI aspects except in the context of their function on a switch. Should Cisco provide any evidence to the contrary I reserve my right to respond.

683. The functional nature of the work is confirmed by the practical means by which network administrators use the CLI aspects. Any experienced network engineer will come to learn commands well enough that they will rarely type in the entire command--instead they will take advantage of command completion to execute the function that is the purpose of the command. Thus, in most instances, the full "expression" (as Cisco would call the command) is not even the concern or interest of the user; she only cares about the first few characters of each command, or only as many as needed to utilize them.

684. The support by any vendor, including Arista, of switching and routing products of substantially the same CLI commands, modes, prompts, hierarchies, and

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responses that end users expect, have been trained on, and are already familiar with, is important to the manageability of, and interoperability within, multi-vendor networks. The importance to customers of supporting familiar CLI features and functionality across different vendors' switching and routing products was emphasized by several witnesses--including corporate witness from direct competitors to both Cisco and Arista--in this litigation.

685. Cisco's own US Patent No. 7,953,886 acknowledges the functional nature of the CLI, as well as the fact that customers have invested heavily into IOS CLI support by developing complicated scripts and access needs, and therefore the networking industry—and not just Cisco—has long strived to support variations on the IOS CLI (namely, the "industry-standard CLI") to acknowledge the existing investments of consumers. *See* CSI-CLI-00355030 (the '886 patent, Specification, "Related Art") (" Access and configuration of a routing system involves sending commands and instructions to and receiving information from the router itself. For routers using a version of the internetwork operating system (IOS), access is accomplished through the use of the IOS command line interface (CLI). ... Many companies now strive to support some variation on IOS CLI in their routing systems, and many consumers have invested heavily in IOS CLI support, developing complicated scripts to handle various configuration and access needs. As such, it is desirable for any improvements to router access and control to acknowledge the existing investments of consumers."); *see also* CSI-CLI-00024454 ('886 patent File History, showing these statements made in 2005 by Cisco as part of the patent application filing). Cisco's very use of the term "industry

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standard" to refer to its CLI demonstrates the functional nature of these aspects of the CLI; they are promoted for what they do, and for their ease of use, not their expression.

686. I incorporate herein by reference all of my discussion and analysis above pertaining to the functional nature of a CLI, including the use of conventional and descriptive terms from industry standard documents, the purpose and nature of the claimed hierarchies, modes, prompts and command responses, and the practical constraints on selecting CLI commands.

C. The Amount and Substantiality of the Portion Taken

687. The third fair use factor is the amount and substantiality of the portion of the asserted works taken. Based on my review of Cisco's copyright allegations, including the materials that Cisco contends comprise each of the twenty-six asserted copyrighted works, it is my opinion that the allegedly copied CLI commands, modes, prompts, hierarchies, and responses comprise only a tiny fraction of the copyrighted works as a whole.

688. I understand that at least as of the date of this report, Cisco has never actually pointed to where any of the commands can be found, as written, in the registered works. Although Cisco lists over 500 commands, I understand that those are spread across three different types of operating systems and many different versions of each such operating system. Should Cisco ever identify where the commands appear in the asserted works, I can endeavor to make a more detailed analysis of the amount and substantiality of the portion taken.

689. Nevertheless, based upon available facts, it is plain that the asserted CLI aspects comprise a miniscule portion of any of the asserted registered works. First, the

CLI aspects do not include any of the functional code that actual manages, configures and operates switches and routers. Clearly that implementing code constitutes the vast majority of each registered version of IOS, NX-OS or IOS-XR. Mr. Satz, for example, testified [redacted].[139]

690. I have also considered the volume of the code in the registered works. These entire operating systems are very large computer programs with thousands of files and functions. [redacted][140] The asserted CLI commands and other aspects do not represent *any* lines of code, they are merely short phrases that the parser part of the overall operating system code recognizes. Therefore they do not constitute even a small percentage of the registered work.

691. It also bears noting that the asserted CLI aspects do not even include the lion's share of the CLI code. That code, which includes the parser and other implementations, is not asserted in this case, but forms a part of the overall operating system code described above. Terry Slattery, who wrote the CLI parser for Cisco in the early 1990s, testified that [redacted].[141] [redacted].[142] By

[139] Satz Dep. Tr. at 76.
[140] CSI-CLI-02638498 at 38.
[141] Slattery Dep. Tr. at 79-80.
[142] He is credited with one CLI command.

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contrast, I am not aware of any evidence suggesting anything more than incidental time was spent arriving at the asserted command words.

692. I have also considered the relative number of asserted CLI commands compared to the total volume of CLI commands in the asserted works. Again, because Cisco has not identified which commands are found in which works, I may update this opinion after Cisco provides such information, Nevertheless, I understand Cisco has estimated that it has over 16,000 commands in IOS.[143] The other Cisco operating systems have some number of additional/different commands, although they have a substantial amount of overlap. Simply using these figures from Cisco, the asserted CLI commands represent less than 3.3% (and probably far below that figure) of all of Cisco CLI commands.

693. Although even this measure shows that the asserted infringement is a very small percentage of the work, this too overstates the overlap in commands. This is because many of the asserted "commands" are not actually commands at all, they are fragments of commands. Furthermore, Cisco lists as different asserted commands variations that reflect nothing more than optional parameters. I do not believe that Cisco has followed any principles in deciding what to assert against Arista in this case (other than where Cisco found there to be overlap), so I do not believe it is possible to replicate Cisco's selection in some objective way. Nevertheless, I attempted to collect all permutations of Cisco commands that roughly approximates the various permutations that Cisco treats as separate commands in its assertions in the case. From that effort, I estimate that there are at least 454,000 distinct Cisco IOS commands. Therefore, based

[143] CSI-CLI-00868542 at 12; CSI-CLI-00866941 at 14.

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upon a count of Cisco CLI commands that approximates the methodology followed by Cisco in selecting what to assert, the asserted infringement here constitutes at most 0.11% of all Cisco CLI commands.

694. Similarly, the CLI commands that Cisco asserts Arista copied comprise a small portion (less than 5%) of the CLI commands accepted by Arista's EOS operating system. Thus, even if one credited Cisco's allegations, the alleged overlap is remarkably small.

695. I should emphasize that this comparison overstates the importance of the asserted CLI aspects because, again, there is no registered work that consists of CLI commands, or the CLI generally. But despite that fact, this comparison still confirms that the alleged infringement is of a *de minimis* portion of registered works.

696. Moreover, [redacted]

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D. **The Effect of the Use Upon the Potential Market**

697. The last fair use factor is the effect of the use on the market for the work. I understand that other witnesses will be providing opinions on this factor. But as noted throughout this Report, and in particular in my analysis of the various networking equipment vendors in the industry above, there is a high degree of overlap in CLI commands among network-equipment vendors. These facts, set forth in detail above, suggest that having common CLI commands or other attributes does not have any appreciable adverse effect on Cisco's market because otherwise Cisco would have taken action against these other industry standard CLI users long ago. I incorporate herein my analysis above regarding the widespread use of common CLI commands throughout the industry as a basis for my opinion on fair use.

698. I also incorporate herein my discussion above regarding Cisco's Tail-f and CiscoWorks network management tools. Those tools facilitate the use of a Cisco or Juniper-like interface even on network devices not sold by one or either company. They also provide for the use of even Arista CLI commands in a product sold by Cisco.

E. **Other Factors Related to Fair Use**

699. It is also my opinion, based on my review of deposition testimony and documents produced in this litigation, that there is a pervasive and long-held belief in the industry that CLI commands are available for anyone to use. This suggests that it would have been reasonable for any holder of a copyright claim in CLI commands to consider the sort of use accused of infringement here to constitute a fair use.

700. This conclusion is supported by many of the observations I make above. In particular:

i) Many vendors have openly and publicly used Cisco-like CLI for many years without any complaint from Cisco;

ii) Cisco sought permission from Stanford to take action against companies with similar CLI in the early 2000s, but only took action against Huawei, who unlike all other competitors, was found to have copied proprietary source code;

iii) Cisco itself promoted its CLI as an "industry standard" and referred publicly to the widespread emulation of its CLI;[144]

iv) Customers have requested "Cisco-like CLIs" or similar requirements as part of product specifications or requests for proposals, indicating that customers did not understand Cisco's CLI to be proprietary or exclusive to Cisco;[145]

v) [redacted][146]

vi) [redacted]

[144] U.S. Patent No. 7,953,886.
[145] *See, e.g.*, ARISTANDCA10200566 at 36 ("the solution should provide a 'Cisco CLI like' configuration").
[146] *See also* CSI-CLI-02868917; CSI-CLI-00943476.

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XIII. TECHNICAL ISSUES RELATED TO COPYRIGHT MISUSE

701. I also understand that Arista has asserted a defense of copyright misuse. My opinions and analyses set forth above may be relevant to copyright misuse and I may be asked to discuss those opinions and analysis for purposes of this defense. In particular, and without limitation, my observations about the sources and lack of originality of the asserted aspects of the CLI, the widespread third-party use of those CLI aspects and Cisco's acknowledgement of such usage, the technical and practical limitations to alternatives to the asserted aspects of the CLI, Cisco's own use of third-party CLI commands, modes, responses, in the Cisco Tail-f and NCM products, and the relatively miniscule part the CLI contributes to the value and operation of the asserted registered works, among other points, all bear upon the issues of copyright misuse as I understand that defense.

702. In particular, asserting copyright infringement by use of common CLI features and functionality, including commands, command modes, prompts, hierarchies, and responses, long after Arista and the rest of the networking industry grew accustomed to their widespread use threatens to disrupt far more than any rights that might exist in the CLI. I am not aware of any distinct market in "the CLI," but forcing other vendors to use different commands than those that have been widely adopted would allow Cisco to use the CLI to disrupt or frustrate the ability of other vendors to compete generally in the sale of Ethernet switches, and to lock customers into Cisco's technology at the expense of more innovative technologies, even though Cisco does not even allege copyright infringement on the functionality of the Ethernet switch operating system. *See e.g.* CSI-ANI-00236944 at 6; CSI-ANI-00272898 at 58.

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703. To the extent that Cisco's asserted copyrights grants them a limited monopoly over any asserted aspects of the Cisco IOS CLI, they are leveraging that limited monopoly to exert control on areas beyond the monopoly.

XIV. CONCLUSION

704. As noted throughout this report, these opinions are based upon the information available to me gathered during discovery. I have not had the benefit of reviewing Cisco's opening expert reports. Given that all of my opinions expressed herein are ultimately in response to whatever theories and contentions Cisco asserts in its case, I intend to refine, and supplement these opinions in response to Cisco's expert reports. In addition, as noted throughout, there are a number of areas where Cisco has either refused to provide, or has not yet provided, the information Arista has requested in discovery. Should Cisco provide further facts or documents or testimony, I will consider those additions in due course to the extent they are relevant to my analysis.